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and Learning
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Pekalongan - Indonesia

Online Teaching and Learning in Science Education

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Preface

Praise be to Allah, the Almighty God for His mercy and grace, so that the author can finish writing the book entitled **"Online Teaching and Learning in Science Education"**. We also express our gratitude to those who have supported the smooth running of this book, starting from the writing process to the printing process.

The purpose of writing this book is to facilitate students in publishing review articles or research articles on technology and online learning pedagogy.

This book will discuss the following important topics: online learning technology research trends in science education from 2015 to 2020 in Indonesia, Project Based Learning (PjBL) to Project Based Online Learning (PjBOL), pedagogy in online learning, planning of online learning in science education, online pedagogical assessment, and selection of online learning media platform in Indonesia.

We really hope that the presence of this book can benefit researchers, academics, educators, and the general public, in helping to improve teaching and learning in the new normal. Thank you to all parties who have participated in publication of this book chapter.

Table of Contents

Introduction to Online Teaching and Learning in Science Education

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The industrial revolution 4.0 is a concept that was first introduced by a German economist, Professor Klaus Schwab. In his book entitled "The Fourth Industrial Revolution", Klaus reveals the four stages of the industrial revolution, each stage of which can change people's lives and ways of working. The industrial revolution 4.0 itself is the last stage in this concept after the stages in the 18th, 20th, and early 1970s. 2018 is referred to as the beginning of the era of the industrial revolution 4.0 which is marked by a cyber-physical system. Now various industries are starting to touch the virtual world, in the form of human, machine, and data connectivity which is better known as the Internet of Things (IoT) (Elayyan, 2021; Spöttl & Windelband, 2021).

To face the era of the industrial revolution 4.0, learning is needed that can form a creative, innovative, and competitive generation. One of these things can be achieved by optimizing the use of technology as an educational aid which is expected to produce output that can follow or change the times for the better. Indonesia also needs to improve the quality of graduates according to the world of work and the demands of digital technology. Learning

process that is compatible with the development of industry 4.0 is online learning. The online learning system is the implementation of distance education in which aims to increase equitable access to quality learning.

Online-based learning is the use of the internet network by students in the learning process (Popa et al., 2020). The online-based learning approach has the following characteristics: 1) requires learners to build and create knowledge independently (constructivism); 2) learners will collaborate with other learners in building their knowledge and solving problems together (social constructivism); 3) forming an inclusive community of learners; 4) utilizing web media (websites) that can be accessed via the internet, computer-based learning, virtual classes, and or digital classes; 5) interactivity, independence, accessibility, and enrichment (Directorate General of GTK, 2016, p.5).

There are several principles that form the basis for the implementation of online-based learning, namely as follows: a) the formulation of learning objectives in each module is clear, specific, observable, and measurable to change learner behavior; b) the content in the module is relevant to the needs of learners, society, the world of work, or the world of education; c) improve the quality of education which is characterized by more active learning and the quality of graduates who are more productive; d) efficiency of cost, manpower, resources and time, as well as program effectiveness; e) equal distribution and expansion of learning opportunities; f) continuous and continuous learning (Directorate General of GTK, 2016, p.8).

The outbreak of the Corona virus or Coronavirus Disease 2019 (COVID-19) which began to spread in

Indonesia since early March 2020, has caused paralysis of various activities both in the social, economic, and educational fields. This epidemic spread so widely and transcended national boundaries, and therefore on March 11, 2020, WHO declared its status as a pandemic. For that reason, the whole world, including Indonesia, the so-called lockdown and social distancing, which have an impact on work from home activities. Thus, the educator's compulsory to conduct online learning. Online learning has made transformations in collaborative learning, adaptive learning, and the way in which a teacher function (Dash, 2019). The achievement of online learning process is depending on the effectiveness of the interaction and communication that happens during the lesson (O'Flaherty & Phillips, 2015).

To fight against spreading of COVID-19, the Indonesian government has prohibited gatherings, social distancing and physical distancing, wearing masks and always washing hands. Through the Ministry of Education and Culture, the Government has prohibited universities from conducting face-to-face (conventional) lectures and ordered them to hold lectures or learning online (Kemendikbud Dikti Circular Letter No. 1 of 2020). Universities are led to be able to organize online learning (Firman, F., & Rahayu, S., 2020).

The form of teaching and learning that can be used as a solution during the COVID-19 pandemic is online learning. Online learning is learning that used the internet network with accessibility, connectivity, flexibility, and the ability to bring up various types of learning interactions (Moore, Dickson-Deane & Galyen 2011; Kuntarto, 2017). Research conducted by Zhang et al., (2004) showed that the use of the internet and multimedia technology is able to change the

way knowledge is conveyed and can be an alternative to learning carried out in traditional classrooms.

Online learning can be carried out with various methods ranging from simple to complex. In general, online learning can be grouped into three methods, namely: full online learning, blended learning, and online support for offline learning (Cahyono & Asikin, 2019). With any method, the online learning process must still contain three interrelated activities, namely: learning the material, discussion interaction, and assessment. The use of technology in online learning is not only a presentation and storage tool, but also as a tool to support interactive learning by actively involving students in information processing, knowledge analysis and design and the application of technology to support decision making (Tu, 2006).

Online learning evolves over time. Various terms are used to express ideas about electronic learning, including: on-line learning, internet-enabled learning, virtual learning, or web-based learning, web based distance education, e-Learning, web based teaching and learning (Cahyono et al., 2019). E-learning is learning by utilizing information and communication technology to enable students to learn anytime and anywhere (Dahiya et al., 2016).

Learning design is related to learning time management and the form of learning activities. The fundamental difference between online and offline learning lies in the nature of the medium and its additional dimensions in time and place that can make learning more interesting and efficient. The concept of online learning is learning anywhere and anytime. Learning can be synchronous (direct interaction) or asynchronous (delayed interaction). Several

forms of online learning activities, for example: lectures in small class scale, lectures with large scale participants, asynchronous lectures, seminars in small groups, synchronous seminars, and other forms (Cahyono & Munawar, 2020).

As an integral part of a program, it is important to evaluate the online learning process. Gaines et al. (2014) developed criteria for evaluating online learning by dividing it into several groups: (a) online learning implementation strategy, (b) online learning materials are in line with the latest research and best practices, (c) the content of learning in accordance with educational standards and objectives to be achieved, and (d) system capacity assessment from a student perspective and from a financial perspective.

Designing online learning is one of the competencies that must be possessed by teachers as part of learning competencies in the era of the industrial revolution 4.0 and society 5.0. Lesson planning is a practice for planning and developing learning activities so that learning objectives are achieved effectively, efficiently, and inspiringly (Moore, 2012). Adequate competence in designing online learning needs to be possessed so that lecturers can prepare online learning planning documents and organize online learning to achieve learning objectives in the courses they teach.

The essence of lesson planning is to determine optimal learning methods to achieve the desired learning outcomes. The main emphasis in learning planning lies in the selection, determination, and development of learning method variables. The selection of learning methods must be based on an analysis of the conditions and learning outcomes.

Lesson planning serves to guide lecturers and students to achieve learning objectives through planned learning experiences, and accountability for the transparency and accountability of learning activities to stakeholders. These two functions are realized in the form of learning design documents with various designations, for example: semester learning plans, learning media, textbooks, modules, and so on.

The advantages of online learning included students are actively engaged in the learning process (Zuo et al., 2021). Flexibility is another major advantage of e-learning as it provides learners the benefit to take classes anywhere and anytime. Furthermore, during online learning teacher can remote learning, easy administration, students centered learning, increase interactivities (Mukhtar et al., 2020). Despite of the significant advantages of online learning, students encounter several challenges which ultimately lead towards either limited or negative outcomes. The internet network and the limitations of students' internet is one of the problems for the students during online learning. Moreover, in the evaluation process are generally held online which reduces the possibility of restricting illegitimate activities such as cheating and plagiarism (Mukhtar et al., 2020).

The science learning process emphasizes providing direct experience to develop competencies in order to explore and understand the natural surroundings scientifically (Chan, 2017). Moreover, science learning is expected to be a tool for students to learn about themselves and the environment, as well as prospects for further development in applying it in everyday life. Science learning studies the phenomena that occur in nature, discusses natural phenomena that are

arranged systematically based on the results of experiments and observations made by students.

The purpose of online learning is to increase the level of efficiency and effectiveness in the learning process (Popa, 2020). Furthermore, the use of ICT and internet has a major contribution in achieving the goals of online learning (Widiyatmoko, 2021). This condition requires students and teachers to be even more literate in utilizing technology (Samari, et al., 2020). The important aspect of students' online learning experiences is students' engagement (Dumford & Miller, 2018). Furthermore, the characteristic of science learning used practical or laboratory activity (Widiyatmoko, 2021). Thus, the teacher needs to find a method that used laboratory activity during online learning in science lesson.

This book chapter will discuss the following important topics: Online learning technology research trends in science education from 2015 to 2020 in Indonesia, Project Based Learning (PjBL) to Project Based Online Learning (PjBOL), pedagogy in online learning, planning of online learning in science education, online pedagogical assessment, and selection of online learning media platform in Indonesia.

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Online Learning Technology Research Trends in Science Education from 2015 to 2020 in Indonesia Case Study: A Systematic Literature Review

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Abstract

Online learning is a learning mode alternative that always develops and is preferred by the educational system implementation. The cost-effectiveness becomes the causal factor of the education to shift the learning into online or networking modes. This research aims to describe the online learning technology research trend and to review the strategies and interactions of online learning technology in Indonesia. The applied research method was a literature study. It reviewed articles about online learning technology from 2015 until 2020 in some databases, such as Google Scholar that were indexed by SCOPUS and DOAJ, the ISSN Journal, and other index providers. This research used a systematic literature review with the PRISMA method. The final analysis consisted of 33 articles. The analyzed articles were from data searches using keywords of "online learning technology, natural science education, in Indonesia." The results were that online learning in Indonesia influenced the interaction, pedagogical, technology, time, and assessment components. The online learning technology implementation has developed before the

COVID-19 pandemic. The most applied research designs to investigate the effects of online learning were quantitative descriptive analysis designs. The online learning technology implementation potential distribution was dominated by discussions about the learning environment shift. Therefore, it was important to arrange strategies to encounter the difficulties in this disruptive era for both teachers and students. They must cooperate with all school components to achieve the educational system advancement especially the 21st-century skills.

Keywords: Online learning, science education, a systematic literature review

Introduction

Online learning is a learning mode alternative that always develops and is preferred by the educational system implementation especially science learning. The COVID-19 pandemic has been influencing various life aspects. It includes education. Education has now adopted online learning to keep the survival of education. Besides that, the highest educational institution believes that online learning is important for the future (Allen & Seaman, 2014). It provides many advantages for the educational system. The cost-effectiveness becomes the causal factor of the education to shift the learning into online or networking modes (Hussein et al., 2020; Limperos et al., 2015). The significant increase toward educational cost difference of high school until the university education levels while applying face-to-face learning could be minimized with online learning. It, is, because online learning is practical and flexible. It could be used anywhere and anytime (Costley et al., 2017; Marzano &

Miranda, 2020). Flexible learning allows students to understand when and how they will learn by adjusting their learning time and their skills.

Online learning promotion brings various problems and challenges. Hodges et al. (2020) & Limperos et al. (2015) explain that the online learning problems are interaction, pedagogy, technology, time, and assessment. Besides that, the online environment brings different challenges to the students. The problems deal with participation, access, community, and teaching supports (Esfijani, 2018; Gillett-Swan, 2017). (Davidson, 2015) found that the students' anxiety in online learning deals with insufficient technology use, lack of support, assessment inequality, and incapability of peer interaction. Technology and the use of online learning are the main problems to discuss in detail. It is to obtain information to be the guidelines of online learning promotion and the assessment reference for similar topics. Besides that, the information about the online learning technology research trend is important to find out the online learning research position.

Many studies to date have considered e-learning as an innovative e-learning strategy for e-learning. (Davis et al., 2018). They identified three effective strategies to be applied in online learning. They were cooperative, simulation and game, and multimedia strategies. Lee (2017) reviewed the accessibility of higher education's online learning. The research deconstructed the general perception of online learning. It covered the online education objectives, online learners' characteristics, and online learning technologies. They found improvements in practice variety and online education reality Moore-Adams *et al.* (2016). They reviewed

the K-12 teachers' preparation to teach online. Their literature review study used the TPACK framework to collect the required cognitive and psychomotor types to teach online. The results were most programs only discussed a little bit of knowledge and skill. They had a variety of diversity about the learning content or experience. Muhaimin et al. (2019) found that most science teachers in Indonesia had been exposed to technology for teaching-learning activities in these last five years.

The integrated technology implementation for learning has been since 2010 but the massive action was seen during the COVID-19 pandemic. Harahap et al. (2019) The study revealed the technology implementation for the learning process could improve learning achievement. It was because technology offered reading opportunities, watching activity, communication, discussion, and writing or typing opportunity. The attempt to use Internet-assisted technology for the learning environment is called e-learning. E-learning could provide various solutions to improve knowledge and performance for encountering social, scientific, and pedagogical challenges (Jethro et al., 2012). The website-based online learning implementation of *e-learning* requires a network. This network allows the teaching materials received by learners via information and communication technology media, such as computers, the Internet network, or the Intranet network (Harahap, Biologi, et al., 2019). Kumar (2017) Argues that the online content implementation needs support from some devices to control the time allotment, location, method, and learning speed.

Although various reviews and research results about this online learning topic have been largely promoted, none

of them reviews holistically about the publication trend of online learning technology in Indonesia. The researchers also did not find any studies showing the development of online learning technology implementations. In this article, the researchers reviewed the online learning technology research trend. They also reviewed the strategies and interactions of the online learning technology in Indonesia. The research problems are:

1. How is the distribution of online learning implementation articles before the COVID-19 pandemic and during this COVID-19 pandemic, for teaching science from 2015 until 2020?
2. How are the research objectives related to online learning technology in science education from 2015 until 2020?
3. How is the research design related to online learning technology in science education from 2015-2020?
4. How the distribution of online learning technology implementation potential from is 2015-2020 based on the data collection techniques?
5. How the distribution of online learning technology implementation potential from is 2015-2020 based on the data analysis technique?
6. How is the distribution of online learning technology integration potential with learning method from 2015-2020?
7. How is the online learning technology implementation for science learning from 2015-2020?

Method

This research applied the literature study method. It reviewed the previous studies that were similar to this current research topic. The studies were trusted literature from trusted sources. This research used a *systematic literature review* with the PRISMA method. The literature review covers some online learning technologies from 2015 until 2020. The literature review activities were identifying, selecting, and synthesizing the research results. Then, the next activity was summarizing the articles based on the investigated topic. The analyzed articles were from data searches using keywords of *"online learning technology, natural science education, in Indonesia."* Here is the flowchart of the research stages shown in Figure 1.
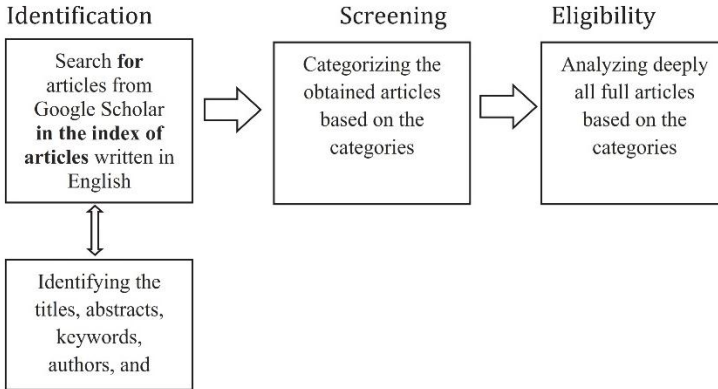
Figure 1. The *systematic literature review* research stage

The first step is identification. The researchers searched for articles based on keywords. They also look at titles and summaries. The researchers then compare the criteria applied according to their specific purpose. Search results from 2015 to 2020 with the keyword "e-learning technology,

natural science education, Indonesia" are software-supported, published or disappeared, with 200 articles. From the article, the researcher identified the relevance, keywords, titles, summaries, and topics developed by the researcher. The applied articles were from *Google Scholar* databases indexed by SCOPUS, DOAJ, and ISSN Journal, or other indexed journals. In contrast, critical-type articles, written books and books, non-scientific teaching and non-English-speaking articles were excluded.

Next, the researchers evaluated the articles based on author, year of publication, research objectives, application tools, results, discussions, implications, research limitations and suggestions for future researchers. After speeding up this writing process, the articles are included based on the topic and you can move on to the third phase, which consists of 33 articles. The third step deals with eligibility and inclusion. At this point, the researchers created a table and tabulated the article criteria into the appropriate categories. These are 1) online engineers doing scientific research before the COVID-19 pandemic and 2) online engineers doing scientific research during the COVID-19 pandemic. The analysis collected 23 articles based on application categories. From the results, 23 articles based on application categories were analyzed and classified according to 1) research type, 2) characteristics of applied e-learning technology, 3) research topics and 4) material content applied to research. 5) Impact of deploying e-learning technology in science education.

Results and Discussion

The researchers identified the articles that met the criteria by conducting a *full-text article* analysis. Table 1

shows the article topic distribution of online learning implementation before the COVID-19 and during the COVID-19 pandemic for teaching science.

Table 1. The article topic distribution of online learning implementation articles before the COVID-19 pandemic and during this COVID-19 pandemic for teaching science from 2015-2020

No	Article distribution	Frequency	Percentage
1.	Online learning, implementation before, the COVID-19 pandemic,	21	63.6%
2	Online learning, implementation during, the COVID-19 pandemic,	12	36.4%
	Total	33	

The learning implementation with online learning technology has been being promoted even before the COVID-19 pandemic. Table 1 shows a percentage of 63.6% of articles share the results about online learning technology before the COVID-19 pandemic. Sulisworo & Toifur (2016) revealed that learning with integrated technology could improve the learners' experience and provide an opportunity for them to participate in an optimal learning environment for their growth. On the educator side, Muhaimin et al. (2019) found that most teachers perceived technology useful to improve learning. Admiraal et al. (2017) also argued that online learning technology development in science education could not be separated from the teachers' roles. Teachers determine the learning implementation success with technology innovation. (Admiraal et al., 2017) Revealed five teacher types based on their beliefs, teaching attitudes to

centralize the learning on the learners and the technology attitudes. The first type is teachers with student-center and technology. The next type is-critical teachers with the technology implementation at school. The third type is teachers that feel uncomfortable with technology. The fourth teacher type is learning activity-centered teaching. Then, the last one is - critical teachers with clear principles. The next categorization was based on conceptual consideration. It covered the teachers' skills to providean online learning environment that should be similar to real-life conditions. It had the purpose to succeed the online learning and influenced the learners' skills to be autonomous learners (Abidah et al., 2020; Sulisworo & Toifur, 2016).

Then, the article reviews also mentioned the objectives of the studies. Most objectives had been revealed and proved their results. These could be seen on their research objective potential points. A percentage of 58% of studies described and evaluated the online learning technology practice (see Table 2). It showed that the online learning implementation average was not maximum. Most studies tried to apply online learning with a very limited number of maximum development trials. These findings are available in Table 2. The table shows the average analyzed articles, 58% of articles aimed to portray, describe, and evaluate the online learning technology.

The science learning activity evaluation showed that the importance of technology implementation. It was to ensure that the online school program met the flexibility criteria, the ideal operational technology instrument, Internet access support, teacher professionalism in learning activities, learning outcome quality, and online learning system implementation supports with excellent category (Luthfi & Hamdi, 2020). It meant the

online learning did not online pay attention to the technical aspect but also the other resource supports and utilities from the learning process. The sufficient facilities, proper environments, and accessible internet would facilitate students to use e-learning (Sukendro et al., 2020). Both parents and teachers admitted the sufficient facilities were the requirement to promote learning from home (Putri et al., 2020). The previous researchers used various designs (see Table 3). However, the most dominating research design is the survey.

Table 2. The research objective potential recapitulation of online learning technology topic on science education

No	Research objectives	Frequency	Percentage
1.	Effectiveness/Measuring the Impacts or Effects	5	15%
2.	Developing	1	3%
3.	Developing and testing the impacts	8	24%
4.	Improving	0	0
5	Describing and evaluating	19	58%
	Total	33	100%

Table 3. The recapitulation of the research design about online learning technology topic for science learning

No	Research Design	Frequency	Percentage
1.	Experimental group	3	9,1%
2.	R n D	10	30,3%
3.	Survey	11	33,3%
4.	Mixed-Method	1	3%
5.	Case Study	3	9,1%
6.	Classroom Action Research	0	0
7.	Analysis	3	9,1%
8.	Evaluation	2	6,1%
	Total	33	100%

The survey technique was frequently used by looking at the online learning technology use for both teachers and learners. Many educators perceived positively toward technology use because it could make the learning process more effective. It could also improve the learners' motivation, encourage the positive attitude of the learners toward the learning, and make learning interesting and joyful (Mahdum et al., 2019). One interesting matter was educators argued the use of ICT could make learners understood better how technology influenced their lives.

The research and development designs could support the online technology so that there would be many media for this 21st century learning to be applied in e-learning (Purwanto, et al., 2020). Besides the technology-based research and development in integrating the main materials, many studies had the function as the complement of technology-based material developments (Taufiq & Amalia, 2017). The technology implementation in online learning needs to consider the learners' skills in keeping up with the learning activities. It was due to learners' lack of skills to access the internet (Rahardjo et al., 2016). The environmental factor also influenced the high accessibility level of the learners. However, it could not maintain the internet use level. The levels of internet facility availabilities were mostly low.

Some analysis researches were such as the correlation of accessibility perception with the utility perception correlation of the perceived utility and attitude correlation of attitude, and the behavioral intention to use e-learning, during this COVID-19 pandemic (Sukendro et al., 2020). Then, based on the revealed research designs. A percentage of 57.7% collected the data with a questionnaire (see Table 4).

Table 4. The recapitulation of the online learning technology use potential distribution on science education based on the data collection

No	The Data Collecting Techniques	Frequency	Percentage
1.	Questionnaire	23	57,5%
2.	Observation	5	12,5%
3.	Uji	1	2,5%
4.	Literature review	2	5%
5.	Interview	7	17,5%
6.	Documentation	1	2,5%
7.	Field note	1	2,5%
	Total	40	100%

A questionnaire could be used to study the beliefs, attitudes, behaviors, and characteristics of the respondents (Krosnick, 2018). Therefore, many researchers used it in survey and development researches. The questionnaire could find out the influential factors that predicted the use of e-learning from attitude, behavioral intention, facilitative condition, and perceived accessibility aspects (Sukendro et al., 2020). The validated questionnaire could be a valid assessment instrument for researchers to explore the online learning environment effects within the latent variable model framework (Rahayu et al., 2021). A questionnaire could be added by triangulation with an interview to obtain more valid data. The results showed that the online learning policies in some areas of Indonesia had hindrances (Febrianto et al., 2020). The hindrances were not only the learning facility but also the socio-cultural condition of the Indonesian people. Most of them could not keep up with this fast-new system. They required consistent and intensive time and training. This policy should be supported by excellent facility provisions from the technical matter and the human

resource. It was to improve the educational system of Indonesia.

This literature review also observed the previous studies, such as the MOOC development in Indonesia. The results were some cites categorized as the most frequently used MOOC platforms in Indonesia, such as Sekolah Pintar, IndonesiaX, SPADA, CodeSaya, MOOC, Universitas Terbuka, and Dicoding (Lubis et al., 2020). SPADA, with its *MOODLE* system (*Modular Object-Oriented Dynamic Learning Environment*), had excellent points. They were as easy to use by the lecturers (Hudha et al., 2018). In the implementation, the e-learning design took form into the *flipped classroom.* This system had three parts: before starting the class during the class and after the class or autonomous tasking (Zainul *et al.*, 2020). Then, based on the data analysis technique, a percentage of 37% used quantitative descriptive data analysis (see Table 5).

Table 5. The recapitulation based on the data analysis techniques

No	Data Analysis	Frequency	Percentage
1.	Anava	1	3%
2.	T-test	2	6%
3.	Descriptive qualitative	7	20%
4.	Descriptive quantitative	13	37%
5.	N-Gain	1	3%
6.	Manova	1	3%
7.	Multivariate	1	3%
8.	Validity	7	20%
9.	Effect size	1	3%
10.	Rasch Model	1	3%
	Total	35	100%

The quantitative descriptive technique described the percentage for both the online learning technology use perception or the technology-based development results. For

example, (Taufiq & Amalia, 2017) observed the percentage of the responses toward natural science learning mobile application with conservative insight in Science conceptual learning. Thus, the results could be used to support paperless action. The most applied data analysis technique was quantitative descriptive with a percentage of 37%. It was because of the trend of survey research.

The t-test has a lower frequency due to the research objectives. The test led to the analysis result that blended learning was significantly effective to improve the learners' science process skills than conventional learning strategy (Harahap, Nasution, et al., 2019). A more complex test was such as multivariate. The test observes the significant difference of the multivariate test results toward the N-gain of the problem-solving skills, curiosity, and cooperation of two groups (Ardhi & Wilujeng, 2017). One of the groups was treated with technology for learning. This research also found various learning methods, like *blended learning*, *e-learning, mobile learning, SNS, TAM, augmented reality, learning courses with moodle based,* and *website*s (see Table 6).

Table 6. The recapitulation based on the applied learning method

No	Research Objectives	Frequency	Percentage
1.	Blended Learning, TPACK	10	28%
2.	e-learning	12	34%
3.	Mobile Learning	4	11%
4.	SNS (media social)	2	6%
5.	TAM	2	6%
6.	Augmented Reality	1	3%
7.	Learning course with moodle based	2	6%
8.	Website (HTML)	3	8%
	Total	35	100%

Sundari & Utomo (2020) Found types of e-learning, such as 1) e-learning that was led by learners to provide an effective learning experience for the learners' autonomy, 2) e-learning led by instructors to deliver the learning materials as if it was a face-to-face class. This learning technology has,a real-time nature. The varieties are such as conference, video, audio, chat, bulletin board, etc. 3) e-learning facilitated by content-web dependability combination led by learners collaboratively and moderated by instructor, 4) embedded e-learning for individuals that want to train their skills and certain knowledge with the assistance of the application, such as Ruang Guru, 5) telemonitoring to monitor, guide, and train learners online. The trends of Indonesia's e-learning included Moodle, Edmodo, Schoology, Quipper Sekolah, and Ruang Guru.

Besides the use of online learning technology, some e-learning implementations used SNS (social media) owned by learners. Habibi et al. (2018) found in their survey that learners used their SNS frequently than other interactions. The use of *Augmented Reality* could be done in learning. It was to facilitate the learning activity with abstract material (Gusmida & Islami, 2017). Most Indonesian teachers used *blended learning* because this model had a significant influence to improve learners' skills (Hadisaputra et al., 2020). However, the data from the field proved that many schools were lack of proper support to promote it (Kane et al., 2016).

The learning technology implementation should have collaborated with peers. It was important to improve the skills, knowledge, and self-efficacy by integrating the technology (Muhaimin et al., 2019). Besides that, the technology implementation in classrooms should have been

integrated into the lesson plan so that it would be optimum (Ardhi & Wilujeng, 2017).

Table 7. The recapitulation of the online learning technology implementation for science education since 2015-2020

No	The Online Learning Technology Implementations	Frequency	Percentage
1.	Learning environment shift	9	27%
2.	Teachers' Perceptions with TPACK skills	7	21%
3.	The learners' self-regulated learning	1	3%
4.	The learners' environmental awareness attitudes	1	3%
5.	The understanding of teachers' candidates	1	3%
6.	Science process skills	1	3%
7.	The learning achievements or learning outcomes	3	9%
8.	The critical thinking skill	1	3%
9.	The learners' activities	1	3%
10.	The learners' problem-solving skills	1	3%
11.	Scientific attitude	1	3%
12	Learners' metacognitive skills	1	3%
13.	The learners' perceptions of online learning	4	12%
14.	Self-efficacy	1	3%
	Total	33	

Table 7 shows the distribution of online learning technology implementation for science education. The ICT implementation had two main functions for learning: (1) as the meant for the users to learn and (2) as the knowledge (Mahdum *et al.*, 2019). ICT has roles to facilitate teachers to understand the material concepts and to deliver the concepts for the learners (Samsudin *et al.*, 2016). This technology is also useful for learners. Sulisworo & Toifur (2016) found that

the economic, gender and ICT literacy backgrounds did not significantly influence the learners' learning outcomes. However, the combination of learning technology and learning strategy could improve the learners' learning achievements. For example, online cooperative learning had a high influence on the learners' achievements. The concentration of Indonesian cell phone users should be used to help improve the quality of education. Mobile learning has the potential to effectively and efficiently improve the quality of learning (Sulisworo & Toifur, 2016).

The technology could also improve the learners' self-efficacy. It would facilitate learners to prepare for their future careers (Mahdum et al., 2019). The learners could reflect the learning to manage and control the thinking process so that they could solve problems (Kane et al., 2016). The ICT ease allowed learners to discuss with teachers without being limited in terms of time, place, and opportunity. Thus, teachers could help learners to solve problems. The ICT ease allowed learners to discuss with teachers without being limited in terms of time, place, and opportunity. Thus, teachers could help learners to solve problems. Dziuban *et al*. (2018) also found, that the roles of teachers,or instructors in online learning were to facilitate learners to reach the objectives to create a supportive environment to learn and to communicate ideas and information.

Many technology implementations were proven effective to improve the learners' skills. Thus, teachers need to apply technology in their learning. However, the data showed most teachers never or seldom used various types of ICT for learning (Mahdum et al., 2019). It was probably caused by lack of facilities, ,internet connection, ,time, and

knowledge about IT. Most teachers argued they had the strategies or specific methods to solve the problems. They also believed that they could integrate ICT with learning activities in the future. Strategies to deal with this disruptive era should cover digital skill development for both teachers and learners. It is also important to cooperate with all school components for the sake of educational system advancement especially with 21st-century skills (Dewi et al., 2019).

Conclusion

The science and technology development in Indonesia has implications on the technology implementation for online learning. Online learning had impacts on interaction, pedagogy, technology, time, and assessment components. Besides that, the online environment brought challenges for students. They were such as participation, access, community, and teacher support. From the meta-analysis results, the online learning technology implementations have been existing since before the COVID-19 pandemic. Most study projects aim to find and discover the effects of online learning. The highest frequency of the applied analysis method was descriptive quantitative with a percentage of 37%. On the other hand, the most dominant online learning technology implementation was about the shift of the learning environment with a percentage of 27%. Therefore, it was important to arrange strategies to encounter the difficulties in this disruptive era for both teachers and students. They must cooperate with all school components to achieve the educational system advancement especially the 21st-century skills.

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Project Based Learning (PjBL) to Project Based Online Learning (PjBOL): Systematic Literature Review on Strategies to Increase Learning Effectiveness during The COVID-19 Period

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Abstract

The 21st century education is facing real-life problems, including technological developments in the era of industrial revolution 4.0 and the COVID-19 pandemic all around the world. The world of education faces a challenge, namely the learning process must be carried out online, so it takes an approach to learning methods and models that are suitable for online learning. Through a literature review, the Project Based Learning (PjBL) model is suitable to be applied to online learning, furthermore it is called as Project Based Online Learning (PjBOL). This study aimed to conduct a Systematic Literature Review towards PjBL to become PjBOL as a strategy to increase the effectiveness of learning during the COVID-19 period. The information about PjBOL was obtained from several international and national journals using the Publish & Perish application for the period of 2015-2021. By using the keywords in article titles containing the words PjBL and online, it was obtained 119 articles. Then selected articles that have been cited by more than 10 readers, and 12 articles

were selected. To support the PjBOL study, a literature review was also conducted on the definition of online learning, its advantages and disadvantages, and its models and methods. Furthermore, from the study of these journals, it will be described about online learning models and methods also their effectiveness on student learning outcomes. This information is then used for the development of PjBL into PjBOL as strategies to increase the effectiveness of learning during the COVID-19 period.

Keywords: Project Based Learning (PjBL), Project Based Online Learning (PjBOL), Online learning, COVID-19.

Introduction

The 21st century education faces real-life problems (Rahmawati, 2020), so skill-based education is needed to deal with these real-life problems as well as the importance of determining methods or approaches in education (Kim et al., 2019). These skills will only be honed if students are actively involved in the learning process. One way that educating students can inspire them to actively engage in learning is a project-based or project-based learning model (PjBL). (Garcia, 2016). Through PBL, students can work, research, answer questions, solve problems, acquire practical, interesting and complex tasks, acquire knowledge and acquire any skill (Rahmawati et al., 2020). Goodman et al. (2010) defined PjBL as a teaching approach that is built over learning activities and tangible task that provides daily challenges for students to be solved in groups. According Afriana (2015), Learning-based projects are learning models. In short, it is student-centered and offers students a meaningful learning experience. Both learning experience of the students and the concept are built based on

the product generated during the learning process based on project. PjBL approach creates learning environmental of "constructivist" where the students build their own knowledge and teachers become facilitators (Goodman et al, 2010). This PjBL model can cultivate students' high thinking level (high order thinking/HOT) on implementing scientific learning (observing, associating, trying, discussing, and communicating) as well as the 21st century learning (4C: Critical thinking, Collaboration, Creative, Communication). By integrating PjBL model with the technology, it can improve the 21st century skills of 4C (Santi et al., 2020).

One of the real problems today is the COVID-19 pandemic that has hit every country in the world. The 2019 coronavirus disease (COVID-19) occurred in Wuhan, Hubei Province, and spread rapidly around the world. Coronavirus or COVID-19 is a large family of viruses that can cause illness, dyspnea, and cough that attacks the respiratory system such as the nose, throat, and lungs (Aan Men, A. and Afrilia, K., 2020). On March 11, 2020, the World Health Organization (WHO) identified COVID-19 as a pandemic (Goddess, 2020). In March 2020, Indonesia was hit by the COVID-19 outbreak (Nurhayati, 2020). The COVID-19 pandemic has affected all levels of education in different ways. Institutions and teachers must respond quickly to the sudden and coercive shift from face-to-face to distance learning. This distance learning is also called e-learning or e-learning (Carrillo, C and Flores, M.A. 2020).

The Indonesian government subsequently adopted an e-learning policy through its Circular no. Published by the Republic of Indonesia (Dewi, 2020; Cucinotta and Vanelli, 2020). This urgent period of the pandemic requires changes

to the learning system that was originally face-to-face online. This policy was implemented to keep learning (Sintema, 2020). In response to changes in education and learning, the Telework Policy (WFH) has emerged, which transforms learning into e-learning (Yunus & Rezki, 2020). The term e-learning teaching model was originally used only to describe learning systems using computer-based Internet technology (ICT). However, with current developments, this online training is not only accessible from computers but also from smartphones (Rosyid et al., 2020).

Based on Indonesian Dictionary (KBBI), online learning, system is a learning system using internet network (e-learning) (Hasanah, 2020). Online learning is an electronic learning process by utilizing information, communication, and technology such as internet (Abidin et al., 2020). This is in line with (Alessandro, 2018) that online learning will involve technology elements as a means and network as a system. Furthermore, (Fitriyani et al., 2020) also suggested that online learning is an innovation in education (learning model) which involves elements of information, communication and technology within a study. Online learning is also defined as learning that takes place in an online environment that uses the Internet for education and learning. This includes online learning for students, regardless of physical or virtual location. Educational content is delivered online and instructors develop educational modules to enhance learning and interaction in synchronous or asynchronous environments (Singh & Thurman, 2019).

The influence of COVID-19 pandemic causes impacts, particularly in the model or design change, as well as the existing learning method. One of them is the teachers and

lecturers One of them teachers and lecturers are required to carry out online learning that is indirectly encouraging changes in learning methods towards student center learning on the whole, which previously was still in the conventional and switch to a more modern learning model (Goldschmidt, 2020). New habits certainly have impact on the selection of new learning models and methods where the activity as well as learning media are becoming a new problem for both teachers and lecturers (Jarwati & Priskawati, 2020).

The emergence of online methods and models is based on the consideration of formal and informal learning, individual and community learning and technologies of learning services (Belawati, 2020), in particular, new emerging practices for scientific learning based on projects. Learning (PjBL). The project-based learning model focuses on contextual learning, where activities can be performed and performed and students can do so according to certain instructions (Fischer et al., 2014). This project-based learning is part of the scientific learning solutions that can be done at the student's home/ accommodation, face-to-face meetings not being possible in the current situation (Saifuddin, 2018).

Based on a review of the above literature, this study describing the use of the PjBL model during a COVID-19 pandemic should be performed online. The transition from project-based learning (PjBL) to online project-based learning (PjBOL) will be at the center of this study. The study also discusses the impact of project-based e-learning (PjBOL) on science learning during the COVID-19 pandemic in Indonesia.

Method

Systematic literature review (SLR) was chosen as the systematic approach to document review. This SLR is defined as the process of identifying, evaluating and interpreting all available research, providing evidence of response for surveys, questions, quality, summary tests and interpretation of the specific results required (Rahmawati et al., 2020). By using this method, the researchers conduct review and identify journals in a structured way which follows the steps that have been set (Triandini et al., 2019). Survey questions are created based on the survey and its purpose. Steps to identify relevant articles, including a list of attempts to answer the research question. International assessments are collected from databases through Google, Schoolar, Publish and Perish, apps using e-learning models, methods and keywords. The national journals obtained through Google search. Among the various articles, the researchers chose 35 international journals and 10 national journals which are associated with the online learning model and methods, as well as the Project Based Learning (PjBL). Later, a deep appraisal was conducted for every single articles to avoid any kind of biases on the evidence. In summarizing, the articles chosen were extracted to collect the evidence. These tests are useful data for answering research questions related to this literature review. The data is aggregated to facilitate the aggregation process. Smaller aggregate evidence may be stronger evidence. The data is then systematically presented based on the survey questions. The final step is to interpret the results, which are the results for the survey question. The findings were based on the

previous steps. Conclusion or recommendation given should refer to the existing evidence (Rahmawati et al., 2020).

The purpose of this research was as literature review which discussed about the changing of Project Based Learning (PjBL) into Project Based Online Learning (PjBOL) as strategies to increase the learning during the COVID-19 period. To answer that question, this article is going to discuss about the definition of online learning, its advantages and disadvantages, its models and methods. Project Based Online Learning (PjBOL) Model the effectiveness of online learning models and methods during the COVID-19 period as well as the implementation of online learning model and methods on science.

Results and Discussion

A. Definition of Online Learning

Online learning is the term first used when the WebCT Web System was developed in 1995 to be the first learning management system (LMS), which was later called Blackboard. In that context, online learning is about using an LMS or uploading text and pdfs online (Bates, 2014). Since then, online learning has included many overlapping terms such as online learning, blended learning online education and online courses. Researchers have always discussed the ambiguity and confusion surrounding the interpretation of the e-learning concept (Singh, V & Thurman, A.2019).

Online learning is defined as hands-on online internet/computer learning in an asynchronous classroom. In this classroom, students interact with the instructor and other students, so the location cannot be determined. Their reality is to participate in this online learning experience.

Another definition of e-learning is experiential learning in a single environment over the Internet. In this environment, students do not need to be online or in class and do not need to interact with instructors or other students as needed. From these two interpretations, online education can be defined as education provided in an online environment that uses the Internet for education and learning. This includes online learning for students, whether physical or virtual. Educational content is delivered online and instructors develop educational modules to enhance learning and interaction in synchronous or asynchronous environments (Singh &Thurman, 2019).

Mustakim (2020) asserts that there are several things related to e-learning, such as the e-learning model, online media, the e-learning method, the obstacles encountered and the effectiveness of e-learning.

B. Advantages and Disadvantages of Online Learning

The implementation of WFH makes students do everything related to learning at home. The learning which is conducted online makes the duration of using cellphones, laptops, PCs or other supportive learning suggestions have an impact on increasing physical complaints. The results of Mustakim's research said that the biggest complaints for physical in online learning are tired eyes, followed by headaches and often sleepy (Mustakim, 2020).

The learning methods used in the online lecture process are synchronous and asynchronous, where each,method has its own advantages and disadvantages. The results of Amadea's research on the difference between synchronous and asynchronous learning stated that they do not have a

significant difference (Amadea & Ayuningtyas, 2020), so the learning during a pandemic both synchronous and asynchronous learning outcomes will be at the same strata. Another study stated that synchronous learning using the zoom platform is easier to implement because the schedule has been adjusted so that students can manage their time easier (Purwaamijaya et al., 2021).

The obstacle in online learning is the network instability which results in misconceptions and even unclear information obtained by students (Chis & Harrison, 2015; Noviantari & Payadnya, 2021) especially on large-scale material on the internet network. Each method and learning model in operating the variables to be conveyed in learning sometimes does not consider the users' or students' environment (Esteban-Millat et al., 2018). Even in online learning with a platform from the Ministry of Education and, Culture in, the form of SPADA. The blended learning model using SPADA is a more tentative model (Anis Chaeruman et al., 2018).

C. Online Learning Models and Methods

Learning model is very close to the learning strategy. Learning strategy is a set of selected policies, which have been linked to the factors that determine the color or strategy, namely: a) selection of subject material (teachers and students); b) presenters of subject material (individuals or groups); c) how to present the subject material (inductive or deductive, analytical or synthetic, formal or informal); and d) target recipients of the subject material (groups, individuals, heterogeneous or homogeneous). While the learning method is a general way of teaching that can be

applied to all subjects, for example teaching with lecture methods, expository, question and answer, guided discovery and so on (Nurdyansyah & Fahyuni, 2016). The learning method was chosen as the first step in determining learning outcomes (Sulistyaningrum et al., 2020). Based on the understanding above, the model and method are an inseparable unit so that a learning model will follow the method used. Learning models in the 21st century are often associated with Information Technology, namely online learning models.

According to Mustakim (2020), there are 3 learning models that are often chosen by students, namely face-to-face, online and blended learning. The model will be achieved depending on the method. The online learning method to determine learning achievement can be covered into 6 categories according to the way of the material is delivered, namely, asynchronous, synchronous, MOOC, mixed/hybrid, blended syncronus, hyflex, and Multi Modal (Martin & Ritzhaupt, 2020). Some teachers stated that using various models in learning will help students accept learning (Aghajani & Adloo, 2018), this is possible because students have different skills. According to Mustakim (2020), Here are some of our students' favorite online learning methods: discussions, quizzes, individual assignments, teacher descriptions, videos, group assignments.

In choosing models and methods, it is certainly necessary to support platforms that support which methods used in learning. This platform selection will support the chosen method of learning (Fahmi, 2020). In online learning, the main thing is how to activate the role of students, especially in improving learning outcomes (Marbun, 2021;

Mujab et al., 2018). Several things that need to be prepared in online learning include (1) a stable internet connection; (2) service facilities in a form of a guideline; (3) tutors to facilitate the online learning process (Mustofa et al., 2019). The most favored online media by students in a row are Google Classroom (53%), WhatsApp Group (21%), Youtube (16%), Instagram (7%), and Zoom (3%) (Mustakim, 2020).

D. Project Based Online Learning (PjBOL)

Dewey's theoretical approach to PjBL asserts that education teaches the meaning of the principles of truth through one's own experience. "Knowledge does more than just show facts in abstract concepts. Instead, knowledge itself is acquired by humans through experience. In Dewey's view, knowledge issues are involved in all problem-solving processes in life and guide students to conduct research related to real issues. Vygotsky's theory of social interaction or the importance of social interaction and practice in the learning process is also the basis of the often-collaborative PjBL method. Vygotsky's theory of social construction considers the separation of social and practical factors in learning as no-no. Because the most important moments of intellectual development occur accurately in communication. This is because social and practical activities meet (Rahmawati et al., 2020). PjBL has four main aspects: (1) use of real-world problems, (2) teamwork, (3) use of multifaceted evaluation, and (4) part of a professional learning network. An important pedagogical approach (Lin et al., 2015). Based on this understanding, project-based learning addresses the need to solve problems by creating products. Using it, students have the opportunity to encourage and develop

innovations to solve their social problems and challenges. In addition, the use of project-based learning is always associated with the development of creativity (Marshall, et al., 2018). At the same time, he enjoys solving community issues and filling in gaps based on his needs assessment. It is clear that some studies have shown that students develop better skills after engaging in interactive online group activities, based on ideas posted there (Dwi, 2016). Project-based learning develops 21st century skills such as critical thinking, problem solving, communication skills, collaborative skills, and creativity. Several studies have shown that comparisons between groups of students using project-based learning methods acquire more 21st century skills than groups that do not (Boss et al, 2011). With learning in the 21st century, online education is becoming more and more popular as an adjunct to the learning process. Previous studies have suggested that students engaged in project-based online learning develop a higher level of understanding of problem-solving knowledge and skills (Lou & MacGregor, 2004). Students emphasized the importance of homework regarding the online environment created by the course itself (Rahmawati et al., 2020).

Project-based e-learning follows five stages, as shown in figure 1. The first stage concerns the problem or task that the learner has to identify. They may do some preliminary research to identify problems that need to be addressed. Then, the planning design consists of several stages. You must select the right innovation based on previous steps, develop the tools to be used, and identify the possible strengths and weaknesses of the developed innovation. The next step involves the student's work schedule. As a fourth step, students are required to

submit assignments three days prior to the scheduled application submission. Based on the presentation, the student's work will be commented on by the teacher and peers. Finally, students must communicate the end results of the innovation developed by providing both an oral presentation and an instructor-reviewed poster (Cholifah et al., 2019). The PjBOL stage shown in Figure 1 is then implemented into an e-learning process that can be applied using pre-existing LMSs such as Google Classroom, Moodle, and LMS applications used in institutions. education department.
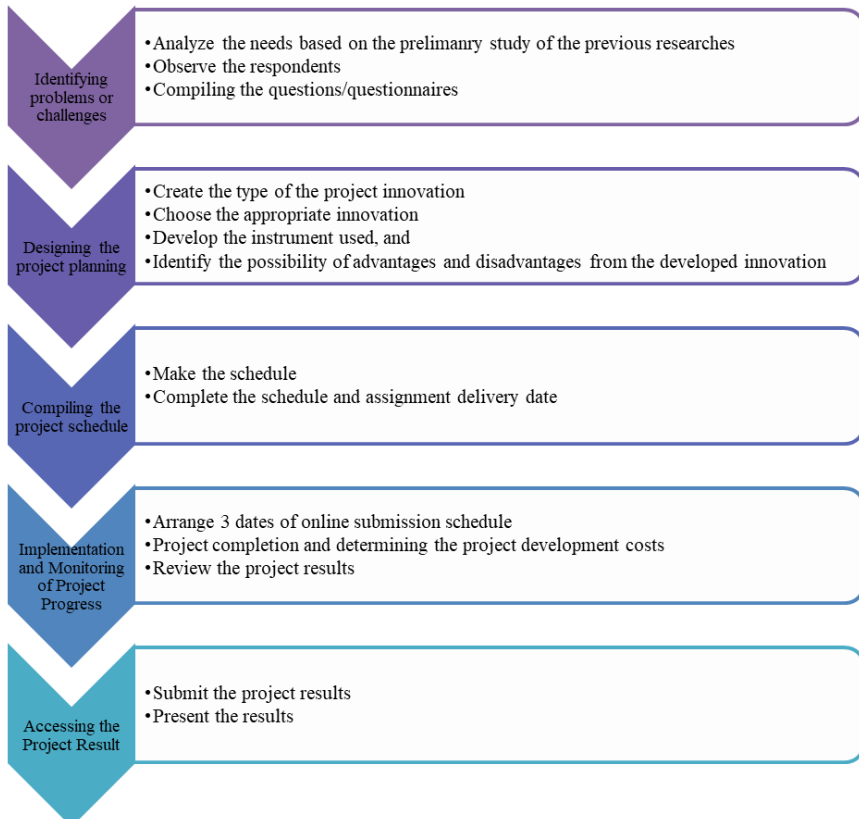
Figure 1. Diagram of the stages in the implementation of PjBOL (Cholifah, P. S. et. al., 2019)

E. The Effectiveness of Project Learning during the COVID-19 Pandemic

According to Mustakim (2020), some students consider it effective to improve learning outcomes. In his research, it was revealed that students accepted the fact that work from home was currently being implemented which requires online learning. Students rated learning mathematics using online media as very effective (23.3%), most of them rated it as effective (46.7%), and rated it as average (20%). Although, there are also students who consider online learning to be ineffective (10%). The use of online media in online learning allows students to have a high enthusiasm for learning and doing assignments. The results of Sianturi's research (2018) showed that the internet use by students can significantly affect student motivation in using e-learning.

The research results of Puspitasari et al. (2018) showed that there is a significant effect of using instructional media on student motivation. It was supported by the results of research conducted by Ibrahim & Suardiman (2014) SD Negeri Tahunan Yogakarta has a positive impact on student motivation and the use of e-learning on learning outcomes. The results of Aurora & Effendi's (2019) research also showed that there is a positive and significant effect between the use of e-learning media and student motivation. The results of Nadziroh's research (2017) showed that e-learning is effective in improving the quality of learning because the learning process is not only fixed in one time and in the room.

Science learning has many possible advantages and disadvantages in science learning. Science learning prioritizes aspects of science skills, especially the accuracy of

choosing a model that is related to the curriculum and institutional support (Mpofu et al., 2012). Learning science itself requires observation and investigation activities to obtain information using methods or hypotheses that have been tested with the scientific process. The scientific process aims to obtain facts and information about the characteristics or other natural phenomena. With physical limitations and perspectives in online learning, it certainly has a big impact on abilities in scientific literacy. Although the online learning can be aided by virtual laboratories (Achuthan et al., 2020), Some course materials are designed and posted on Moodle's LMS, or on messaging systems, blogs, chat rooms, Wikipedia, videos, articles and other platforms. Students can access teachers synchronously, asynchronously, or both (Elçiçek & Karal, 2020) but the essence of science learning cannot be maximized.

The effectiveness of PjBOL can be seen from previous studies, including those conducted by Biasutti and Deghaidy (2014) using Moodle platform. The results show that processes related to collaboration and online activities can develop the capacity of teachers to design projects in an interdisciplinary context. The discussion will focus on aspects of the online environment that make collaboration effective for learning. Cakiroglu & Erdemir (2018). Conducted a case study to investigate the role of teachers and students in the design of project-based learning activities using information technology. The findings suggest that cloud computing facilitates planning, collaboration, communication, and also supports individual learning in project-based online design activities. Research on PjBOL was also conducted by Chanpet et al. (2018) by investigating

the possible role played by technology in using PjBL and online assessment formats in media creation courses at Thai universities. The results revealed that technology provides the basic scaffolding to support student-instructor activities and interactions. Design a simple learning management system with file sharing and communication tools to support students and teachers, evaluation and learning processes. According to Cholifah et al. (2019), to meet the learning needs in the 4.0 era, project-based e-learning is an innovative initiative of the project-based e-learning model that is positively impacting the resilience of students while learning during the pandemic of COVID-19. It has proven itself, be an alternative to learning processes that can be encouraged and developed (Rahayu & Fauzi, 2020). PjBL assisted by e-learning and the development of self-efficacy have a positive effect on learning outcomes for understanding concepts. Its influence affects and is significant on the strength of learning models, the power of online learning (Google Classroom), classroom interaction and group collaboration, materials and media. and educational outcomes to understand the concepts. Supported by the donation environment. Two variables, PjBL and SelfEfficiacy, have the advantage of being applicable to e-learning-supported learning, depending on the current era of ICT development (Salehudin, 2020).

Conclusion

Based on the results of literature review by using the Systematic Literature Review (SLR) above it can be concluded that the model of Project Based Learning Online (PjBOL) is an online learning model that is needed in the 21st century, to face the real-life problems. The real problem in the world of

education today is the COVID-19 outbreak which requires online learning. In addition, the development of technology is very rapid in the era of the industrial revolution 4.0, the world of education should not be left behind. The development of PjBOL is a must for all stakeholders in the education world, such as educational institutions, teachers/lecturers, students, as well as parents must master technology for successful online learning. The selection of PjBOL is very appropriate because it is proven to be effective in learning and it can increase understanding of concepts. Furthermore, PjBOL is expected to answer the challenges of the 21st century by cultivating high order thinking (HOT) in implementing scientific learning (observing, associating, trying, discussing, and communicating) and 21st century learning (4C: Critical thinking, Collaboration, Creative, Communications)

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Pedagogy in Online Learning: Systematic Literature Review

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Abstract

At this time the popularity of online learning has increased significantly. With the COVID-19 pandemic, online learning is increasingly being applied in the world of education. The purpose of this study is to analyze the pedagogy of online learning. Data were analyzed by quantitative descriptive. The first thing the researchers did was a survey of science teachers at the high school level regarding TPACK in online learning. Next identify the characteristics of online learning, increase TPACK. Based on the results of a survey on TPACK from 63 respondents who came from physics, biology, chemistry teachers throughout Jepara Regency, learning strategies and technology according to the material obtained the highest percentage of 77.8% (good) and the lowest percentage 52.4% (poor). Knowledge, technology, pedagogy.

Keywords: Pedagogy, Online Learning, TPACK

Introduction

During this time, online learning has grown dramatically in popularity. The presence of e-learning during the COVID-19 pandemic is increasingly being applied in the

field of education. E-learning or distance learning or e-learning is basically a tool (support) to overcome the problems of distance, time, cost, and limited education staff. Online learning does not completely rule out the strength and interaction of education in learning that some people may fear or worry about. Long before the advent of Internet technology, distance learning courses were offered to provide students with training in specific subjects and skills. How to approach e-learning technology from an educational and learning perspective today.

The 21st century has entered the information age where digital skills are seen as important. It gives students the confidence, abilities and skills to create, develop and correlate new information not only to manage, analyze and filter information, but also to solve social problems. In this powerful new world of learning, it is essential to double the teaching. We need to teach digital skills to face and act in this world, but we also need to teach the ethical parameters by which students live and work digitally. The creators of new knowledge must realize that they are still part of a community, responsible and a member of that community. Therefore, in order to enable students and teachers of the Digital Moment educational strategy to connect on a human level, Scardamalia & Bereiter (2006) argue that an educational strategy that aims at a fundamental revision of education. Students in a culture of knowledge building. In this context, the Internet is more than just an office library or a high-speed messaging system. It is the first practical way for students to connect to a civilization's vast knowledge base and integrate the classroom into it. Therefore, guiding students through a culture of knowledge creation is a

cohesive effort. In this context, the Internet is more than just an office library or a high-speed messaging system. It is the first practical way for students to connect to a civilization's vast knowledge base and integrate the classroom into it. Thus, it is a cohesive effort to guide students in a culture of knowledge construction. In this context, the Internet is not just an office library or a high-speed mailing system. It is the first practical way for students to connect with the vast knowledge building of a civilization and integrate the classroom into it.

Teachers' planning to integrate pedagogical skills into education should be based on the relationship between curriculum requirements, students learning needs, available technical skills and limitations, and the realities of the situations at hand, school and classroom. This technology-integrated approach focuses on content-based learning activities (Freidhoff, 2008). Competencies and Limitations of Educational Technology to Support Student Learning Activities The complex knowledge required for such planning is called knowledge of technical education content. Part of the teacher's technical pedagogical knowledge will be used when planning lessons. Studies of teacher planning show that it is organized and communicated primarily through content goals and learning activities (Harris & Mark, 2011). The complex knowledge required for planning is known as technology, pedagogical content, knowledge (Mishra & Koehler, 2006). Technology, pedagogy, content and context knowledge (TPACK). TPACK is a specialized and highly applied knowledge type that, supports the integration of content-based technologies.

TPACK is an extension of Shulman's (1987) The concept of content knowledge educates the expertise needed for different education in different content areas and revolutionizes teachers' understanding of knowledge and its development. Overall, teachers in this study believe that the nature of the curriculum content is best learned by students, and how they can best use different technologies to support such learning in the classroom. I compared.

There are many techniques for online education, such as sociological learning through social interaction between peers (Thoms & Eryilmaz, 2014) gamification or incorporation of, games into, education, for example, through learning platforms or video games (Urh et al., 2015) and personalized learning tailored to individual approaches to student strengths and weaknesses (Cakula, 2013). All these methods are used to ensure high knowledge retention and good content absorption. This makes the use of distance learning more feasible and accessible in most cases. Distance learning went mainstream during the COVID-19 pandemic (Sinsiani et al., 2020; Dhawan, 2020; Al et al., 2020; Armstrong et al., 2020). Distance learning both in secondary and higher education is a technological development perspective.

The purpose of this paper is to analyze, online learning pedagogy from the characteristics teaching methods strategies and skills in learning. Based on this analysis, it is the basis for researchers to make a study on how online learning pedagogy is effective and efficient.

Method

This study was a quantitative study and the data were analyzed using a quantitative description. This review

includes published research on TPACK and online learning pedagogy. The survey was conducted on physics chemistry biology teachers at the high school level with a total sample of 63. Research on online learning pedagogy can be searched through a freely accessible web that indexes full-text research articles by writing the keywords TPACK and online learning pedagogy.

This study includes published research and briefly discusses online learning pedagogy. The approach used is a quantitative approach. The content analysis method as a quantitative research method is used in this study, and there are four steps that must be carried out, namely (1) a TPACK survey in online learning, (2) identifying research questions about the characteristics of online learning, how to improve TPACK, (3) analyzing online learning pedagogy, and (4) presenting conclusions. The data used in this study are surveys and articles related to online learning pedagogy according to the topic and research objectives. Survey results, articles, reference books are used to analyze.

Results and Discussion

Based on the identification step data, related to questions about:

What are the characteristics of online learning?

E-learning as a concept includes various applications, methods and learning processes (Rossi, 2009). Hawkins (2008) Its e-learning has moved from a purely online course to using technology to offer some or all of its independent courses. E-learning is a new application of multimedia and Internet technologies that improves the quality of learning by

facilitating access to facilities and services, as well as distant exchange and cooperation in time and space. Online learning can be done anytime, anywhere.

Based on the rapid growth of e-learning as a primary pedagogy in education, significant research has been undertaken to investigate the impact of internet-based technology, and current advances in Online learning has led to innovation. There are different definitions for e-learning, but there are some general definitions that include engaging in a learning experience facilitated by the use of a particular technology (Moore et al., 2011). In some contexts, e-learning involves a "hybrid" approach that includes face-to-face learning supported by the delivery and interaction of online content.

According to Rosenberg (2001) the characteristics of E-learning is a network that allows you to quickly retrieve, store, retrieve, distribute, share, and learn information. The characteristics of E-learning (Nursalam, 2008) include 1) utilizing electronic technology services, 2) Utilizing the advantages of digital media computers and computer networking, 3) using self-learning teaching materials which are then stored on a computer, so that they can be accessed by students and teachers. students anytime and anywhere, 4) take advantage of the learning schedule, curriculum, learning progress results, and matters relating to educational administration that can be viewed at any time on the computer.

Research result Burke & Stephen (2020) verify the importance of applying nursing pedagogy to online education. The Noddings Framework provides a compelling model for hands-on guidance for online educators. Student

feedback data shows that modeling, the first component of the framework, is essential to promote a culturally safe and comprehensive online environment and that students experience the feeling of being cared for. It is clearly shown. By maintaining care orientation through online-centric interactions, students can better understand the behaviors that drive the dynamics of care. Cram & Lamond (2016) Led by Caring Quality, he studied the design of a targeted online course called Digital Mediated Learning that defines lasting student engagement by providing effective teaching methods for online students.

According to Marc et al. (2006) As a measure of behavior, it is important to note that students are making positive profits in the overall success of online learning. Similarly, students experienced positive improvements in computer skills, online learning needs, and learning skills. By teaching homework online, students improve their computer use, online literacy skills, and show more independent behavior in responding to requests. This finding confirms that the concepts measured here are behavioral and therefore easier to learn than the concept of attitude.

How to Increase TPACK?

In the global context, a pattern of teacher competency development is developed which is called "TPACK" or Technological, Pedagogical, Content. Knowledge in essence, a teacher must have comprehensive and holistic knowledge, and skills in terms of content or material, pedagogy, or educational science and technology. Researchers in various countries have published their research results related to "TPACK" as an effort to develop teacher competence. Like

the research of Baran et al. (2011), the result is that TPACK becomes an effective tool and way to explore the ability of teachers in terms of mastering technology, and,their ability to use technology in learning.

TPACK was developed based on the learning model proposed by Shulman, which explains how the understanding of content mastered by teachers, pedagogical knowledge and technology are interconnected with each other, especially based on understanding processes and methods to organize effective and efficient learning (Lin et al., 2015). TPACK can be interpreted as a form of knowledge which is a synthesis of three content knowledge, pedagogical knowledge and context knowledge. This concept was further developed into TPACK because it added elements of technology. The TPACK model is shown in **Figure 1.**
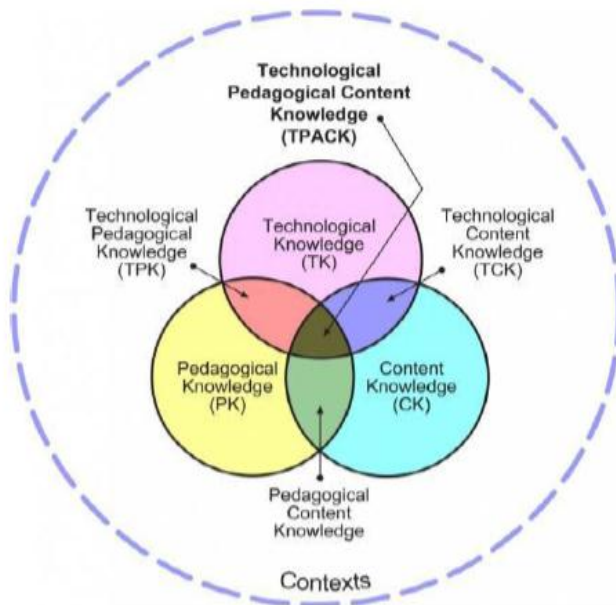
Figure 1. TPACK elements

Based on Figure 1 shows that TPACK is not only built from three knowledge bases, namely content knowledge, ,pedagogical, knowledge, and technological knowledge (Lin et al., 2015; Baya'an & Daher, 2015). However, there is a combined knowledge that is also considered important in TPACK, namely content pedagogical knowledge (PCK), content technology knowledge (TCK) and pedagogical technology knowledge (TPK). The elements of TPACK in detail can be described as follows:

1. Content Knowledge (CK), content knowledge is a form of knowledge about the actual subject matter that will be taught. Content knowledge is very importantfor teachers. This knowledge includes knowledge of concepts, theories, ideas, frameworks of thought, real knowledge, evidence, laws, principles, practices and approaches to develop this knowledge.

2. Pedagogical Knowledge (PK), Pedagogical knowledge is in-depth knowledge of processes and practices in delivering the content to be studied or learning methods that include learning objectives, values, and learning processes.

3. Technological, Knowledge (TK), technological knowledge is knowledge of standard technologies, such as books and teaching aids. More advanced technologies, such as the internet and digital video. These skills are needed to use certain technologies.

4. Pedagogical Content Knowledge (PCK), pedagogical knowledge and content related to pedagogical knowledge that applies to the teaching of certain content according to the characteristics of the material to be

taught. PCK includes core material, learning process, curriculum, assessment, and learning outcomes.

5. Technological Content Knowledge (TCK), Technology and content knowledge is a form of knowledge about the existence of technology and the capabilities of various technologies such as those used in the learning process, knowing how to teach and learning arrangements, knowing how learning outcomes change due to using certain technologies and vice versa.

6. Technological Pedagogical Knowledge (TPK) is a form of knowledge to improve practical pedagogical abilities which include teaching skills, assessment and learning motivation due to the use of technology applications in the learning process. Teachers need preliminary study data to strengthen the need for technology applications in the learning process.

7. Technological Pedagogical Content Knowledge (TPACK) is a form of knowledge, that transcends all components, namely content, pedagogy, and technology, which is an understanding that arises from the interaction of knowledge, content, pedagogy and technology. To improve the ability of TPACK can be done with the existence of a training strategy, in this study conducted a training program on TPACK, as well as concepts, technology, and learning strategies as a strategy to improve the ability of teachers' TPACK. Koseoglu (2012), the training was carried out by several teachers who stated that after knowing some of the technologies described during the training, they were interested and inspired to start implementing them in learning.

Online Learning Pedagogical Survey Results Data

The results of the online learning pedagogy survey were carried out by distributing, questionnaires, through a google form containing statements and questions to explore the extent of the understanding of the teachers.physics, biology, and chemistry in high school in Jepara district. Respondents who provided data were 63 teachers. Questions related to TPACK can be seen in Table 1.

**Table 1**. Questionnaire for aspects of technological pedagogical content knowledge

No	Question	Category				
		Very good	Good	Average	Poor	Very Poor
1	Can make lesson plans (RPP) with a good understanding of topics according to subjects	12	47	4	0	0
2	Can choose learning strategies and technology that are in accordance with the material to be delivered in learning activities	7	49	5	1	0
3	Can understand how to combine my knowledge, pedagogic knowledge, and technological knowledge to realize meaningful learning	8	44	10	1	0
4	Able to apply various learning strategies and various technologies in carrying out learning	4	43	14	2	0
5	Can make material on difficult subjects easy for my students to understand	8	39	13	1	0
6	Can help my colleagues understand how to combine knowledge, pedagogical knowledge, and technological knowledge	7	33	22	1	0
7	The activeness of students in participating in online learning.	4	35	18	5	1
8	Student learning outcomes carried out during online learning	3	35	22	3	0
	Average	8.75	39,375	12.875	1.75	0.125

Based on the data obtained, it shows that of the 8 TPACK indicator points, almost all of them scored in the good category. This shows that, basically, teachers already have good pedagogical abilities in online learning. Of the eight indicators, it shows that teachers have good pedagogical abilities in online learning. Indicator 2 gets the highest score, followed by indicators 1, 3, and 4. This is in line with the results of research from (IAPSatyani, 2021) which states that all teachers are able to use various methods, most of them are able to use various online-based learning media, most teachers are able to use the environment as a learning resource. The increase in the ability of these teachers has an impact on the learning activities presented.

On the other side teachers should be given an understanding of how the techniques and strategies in character education in online learning are the embodiment of learning from home. Teachers must try to be creative in exploring information and characteristics of students in determining learning models with the expected learning outcomes in online learning (Santika, 2020).
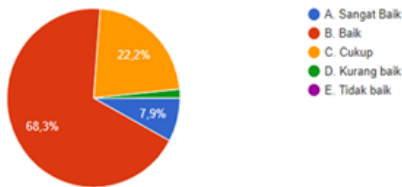
3. Dapat memahami bagaimana memadukan pengetahuan, pengetahuan pedagogik, dan pengetahuan teknologi yang saya miliki untuk mewujudkan pembelajaran yang bermakna
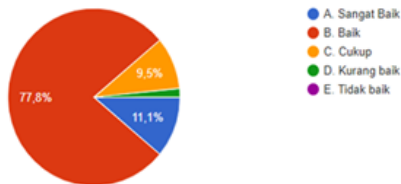
63 jawaban
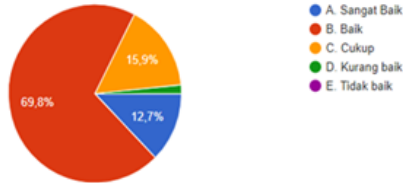
4. Dapat menerapkan berbagai macam strategi belajar dan berbagai macam teknologi dalam melaksanakan pembelajaran
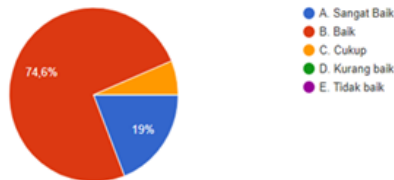
63 jawaban

2. Dapat memilih strategi pembelajaran dan teknologi yang sesuai dengan materi yang akan disampaikan pada kegiatan pembelajaran

63 jawaban

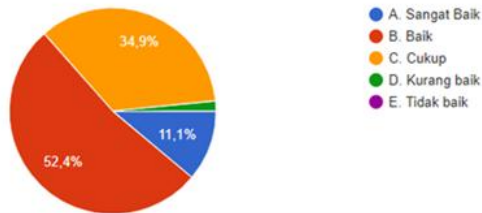1. Dapat membuat rencana pelajaran (RPP) dengan pemahaman yang baik tentang topi-topik sesuai mata pelajaran

63 jawaban

Figure 2. Pie chart of the result question about pedagogy in online learning at number 1, 2, 3, and 4 questions

James (2020) statesmonitoring in the Zoom class is able to improve teacher professionalism in determining online/remote learning media. The results showed that PJJ with BDR (Learning From Home) with an Online, Offline or Combination system was able to improve teacher competence in learning. In Cycle-1, there was an increase in teacher competence in PJJ by 3.9%. However, this increase was successful when compared to the research success criteria with a percentage increase of 5%. In Cycle-2, the increase in teacher competence in PJJ was 4.2%. In Cycle-3, the increase in teacher competence in PJJ was 14.1%. "This research was successful because there was an increase with the research success criteria of 5% (Ahmad, 2020).

Figure 3. Pie chart of the result question about pedagogy in online learning at number 6 questions

In indicator 6, it explains how to be able to realize the character of cooperation between colleagues. Online learning pedagogy fosters a sense of mutual assistance between teachers in terms of mastering online technology and solving problems in online learning. Indirectly learning becomes an alternative to solve learning problems faced by teachers as well as an effort to improve teacher competence in learning.

This activity can be continued, developed in a wider form through partnerships (IAPSatyani, 2021).

However, in providing evaluations during online learning, one should also pay attention to the level of difficulty of the questions given to provide valid data related to online learning pedagogy (Setiyawan, 2020).
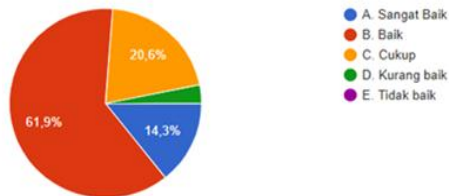
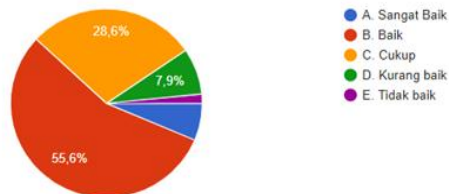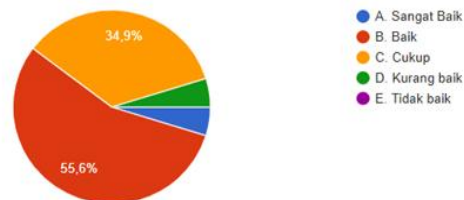**Figure 4**. Pie chart of the result question about pedagogy in online learning at number 5, 7, and 8 questions

Conclusion

From the research results, we can conclude that the pedagogical aspect has a great influence on the development of teaching materials (content development) and on learning (learning) by focusing on the pedagogical relationship. Within the app, for example via the feedback function. Anticipation of Pedagogical Didactics (the relationship between teacher-material/technology) in educational applications, can be done by adding features that contain things that students like and interest students. Based on, the results of a survey on TPACK from 63 respondents from physics, biology, chemistry teachers throughout Jepara Regency, learning strategies and technology according to the material obtained the highest percentage of 77.8% (good) and the lowest percentage of 52.4% (unfavorable) combines knowledge, technology, pedagogy.

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Planning of Online Learning in Science Education

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Abstract

The purpose of this study is to analyze how to plan of conduction online learning in science lesson. This study used the literature review method. The researchers sought the international articles by the assistance of search engines and manual. The applied keywords were online learning, e-learning, and science learning. The characteristics of science learning plan in online learning context are the learning process period, learning activities to do, discussion topics to assess, determining task provision method. Online science learning plan, and online science practice design should have clear visions about the objectives and the intended results. Thus, it was important to determine the pedagogy and the promoted activities as well as the applied platform.

Keywords: Planning, Online Learning, Science Education

Introduction

The e-learning advancement within the first decade of the 21st century brings the online approach to be used widely by many educational regulation. Rodriguesa (2019) added emphasis and workload experienced by the faculty and

university staff. They have struggled to put their teaching, researching, and volunteering tasks equally but they could not. Moreover, they also had problems to put their working lives in balance (Houston et al., 2006; Houlden & Veletsianos 2020). Teachers come from different backgrounds and ages. They have to prepare and deliver courses at home, with all the practical and technical challenges, without the proper technical support (Hodges et al., 2020).

Accessibility, accessibility, selectivity, pedagogy, lifelong learning and politics are discussions related to online pedagogy. This model would be accessible online, although it can reach remote locations. Therefore, it is considered a relatively inexpensive form of education in terms of transportation, accommodation, and tuition. Flexibility is a specific and exciting aspect of online learning. Students can schedule or schedule time to complete the online course. The combination of face-to-face learning and technology provides integrated learning and blended learning spaces. This learning environment has the potential to increase a student's learning potential. Learners can learn anytime, anywhere, allowing the acquisition of new skills during the orientation for a long-term learning process. The government also recognizes the importance of online learning in this dynamic world.

Literature Review
A. Online or *E-learning*

The fast-growing technology advancement makes distant learning easy (McBrien et al, 2009). Many terms such as e-learning, open learning, e-learning, computer-aided learning, blended learning, and m-learning have similar online computer

skills. It offers the opportunity to learn anytime, anywhere, in any mode, at any speed (Cojorariu et al., 2014).

Many terms such as e-learning, open learning, e-learning, computer-aided learning, blended learning, and m-learning have similar online computer skills. It provides the ability to learn anytime, anywhere, in any mode, at any speed (Singh & Thurman, 2019). The structured-synchronous learning environment for students is to attend course directly. This meeting has real-time interaction between educators and students. This mode also allows instant feedback. On the other hand, the asynchronous learning environment is not structured well. The learning environment makes the learning content unavailable in the form of direct courses or classes. However, it is available in the forms of systems and learning forums. The instant feedback and indirect responses are impossible to do in this environment (Little field, 2018).

The synchronous learning provides many opportunities to interact socially (McBrien et al., 2009). In the middle of the virus outbreak, an online platform, for example (a) video conference with 40 until 50 people is possible to apply, (b) discussion with the students should be done to ensure the class organic, (c) excellent internet connection, (d) course should be accessible via smartphone and not only laptop computers, (e) accessibility to watch the recorded courses, and (f) instant feedbacks for students and taking the tasks (Basilaia et al., 2020). The synchronous learning provides many opportunities to interact socially (McBrien et al., 2009).

B. Online Learning Plan

The general shared definition in an extensive literature review, Adams (1987) provides seven different definitions.

However, all of them are considered incomplete. One of the clear reasons is - the word *plan* is perceived differently by people for the different objectives. However, the most common elements for any definition is - involving individuals to think and develop strategies to prepare their future organizations A plan lasts in all organizations although it has different characteristics.

Plans can be structured, formal, *top-down*, non-participative in several cases, structured, informal, *bottom-up,* and participative. It also involves the social and administrative complex phenomena concerning the financial resources, personality, individual needs, and departments. Schools, higher educations, universities are social system that run the activities including plans. They usually consider the learners', teachers', administrators, and community needs in a wider social environment context. The definition shift of plan into a common element will have function to define and explain the plan for this article. This approach is considered as exaggerating simplification from complex topics. However, this approach recognizes and respects various situations. Based on the explanation, the research formulations are:

1. How is the science lesson in the context of ADDIE-online learning model?
2. How are the characteristics of science learning in online learning context?
3. How is the science learning practicum design in online learning context?

Research Objective

This research aims to:

1. Describe the science learning plan in online learning context with ADDIE model.
2. Describe the science learning plan characteristics in online learning context.
3. Describe the science learning practicum design in online learning context.

Method

This study used the literature review method. The researchers sought the international articles by the assistance of search engines and manual. The applied keywords were *online learning, e-learning,* and science learning. The articles were re-selected to obtain the relevant articles with the questions. Some related books with online learning were used as reference to enrich the article discussion.

Results and Discussion

A. Planning the Science Learning in Online Learning Context with ADDIE Model

ADDIE model is the most applied traditional model to develop e-learning system. It consists of analysis, design, development, implementation, and evaluation before previewed and revised. The stages were previewed and evaluated before undergoing the next stage. Figure 1. illustrates the ADDIE model development process This is an agile model to develop a quick system that involves the customers' participations at all stages.
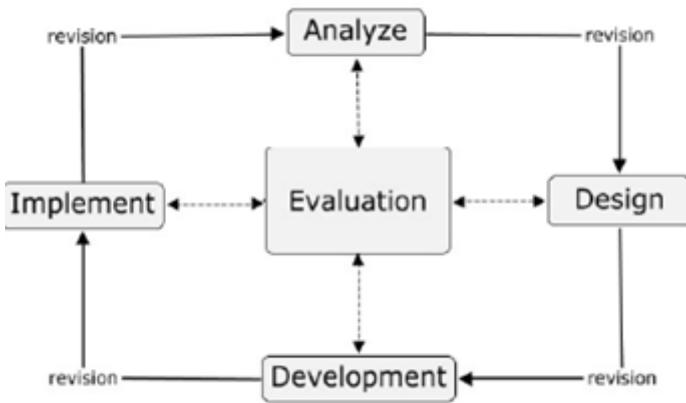
Figure 1. The ADDIE model plan (Morrison, 2010)

The development process was started by requirement stage, brief initial plan, quick design, and prototype based on the plan and the available requirements. The model was sent to the customer to be evaluated and previewed. The feedback of the customer and user were noted. Then, a new revised model was created based on the feedback.

1. The Analysis Stage

This analysis stage consisted of requirement system and information from the factual collected information. The researcher determined the gap of actual behaviors and the targeted objectives. Information about learners, environment, applied technology, and scientific content were used to close the gap. Here are the instruments to collect data and analyze information. Research or questionnaire Direct and indirect observation and interview

a. The analysis stages were

Collecting information about e-learning system and the need analysis. It consisted of some stages, such

as arranging information document, identification of learning topic, and guideline identification.

b. The analysis of educational objectives

   The objectives or the results were clarified after understanding the natures of the works and the learning objectives. The obtained results were for all required skills to achieve the targeted objectives.

c. Defining the sub-tasks and behaviors

   This stage was the most important stage to develop the behavioral learning objectives into educational content principles. In this stage, the sub-tasks and specific behaviors were defined to reach the educational objectives.

d. The target group identification

   The targeted groups (learners and training participants) were analyzed in terms of their behaviors, environments, and academic backgrounds because the information strongly influenced the personality of the scientific content selection.

e. Identifying the instrument and the applied technology

   In this stage, the researchers identified the instruments and the applied learning technologies for the learners. The technical instruments were grouped into two main parts (Horton, 2003).

   1) Hardware tools: The instrument is inside or outside the class to facilitate the e-learning. It may take form into computer or network connection type.

   2) The software instrument: the application and the types of installed software in computer and e-learning management system. After selecting the

learning instrument, the applied technique was analyzed. The researchers also consulted the scientific content design with the technical supervisors to understand the technological limitation and the developed limitations by the IT department.

f. Security and privacy

In this stage, the security and privacy mechanism was identified to prevent e-learning system penetration. It was important to plan an alternative if an individual lost his information or the information was damaged. The researcher selected the security algorithm, encryption method, and the process to copy the information back up (Luminita, 2011).

g. The update and improvement of the system and scientific content

In the last stage, the sophisticated mechanism was identified and the revision would be held later in the future, for example scalability, extension, lecturer recruitment, student recruitment, course addition, and science mechanism. The updated and upgraded contents easily and flexibly became the feedbacks of the users.

2. The Design Stage

In this stage, the applied analysis stage was used to create the required sketch for *e-learning* and the scientific content. The result of this stage was the document design. The document design covered the objectives, educational strategies, and scientific content design. The applied document was used to communicate among

team members and to keep the project in track. It was important to make the project focus on the educational objective. Some studies and researchers proved the use of document and important design pattern for developing and becoming the standard of learning element design (Janssen, 2007; Zheng, 2015; Mor, 2014). After modifying, the final design scheme of the e-learning system was validated by all parties and compared with the lecturers' and students' notes.

The e-learning system planning stages were: (1) determining the learning objectives, (2) developing the scientific plan, (3) determining the question, and (4) defining the available technology. The legal document design identified the available technology for both students and lecturers. It also became the determining factor that could be identified by online learning users.

3. The Development Stage

In this stage, the researchers selected an appropriate platform to plan the e-learning system. Many platforms were available in terms of design, specification, forms, and preparation methods, including the commercial and open source natures. They were such as Moodle (Dougiaman, 2003) and Google Classroom (Iftakhar, 2016). Some guided questions to develop the online learning media were: What is the purpose to involve your students in your system? What kind of scientific content to teach? How do you put the scientific content? How many users are there? Will you host the system or will you use external host? How much your budget to purchase this system? What kind of system

will it be? Is it possible to trace the students' progresses? In the development stage, the researchers evaluated and tested the design. The evaluation was done by showing the system to the stakeholders, such as students, lecturers, and content designers. The notes were carried out. Besides that, the technical device recording was also checked by the system. Each test was documented.

4. The Evaluation Stage

This evaluation was for all planning stages. It provided opportunities to revise any weaknesses. Besides that, the evaluation was conducted in the end of a learning meeting. Thus, the students could be assessed via online test. The test also covered daily task designs and practices. Besides that the learners' online learning evaluation also required the learners to make video and audio, add text files, and do instant conversation between lecturers and students, and provide specific forum for students to discuss. The system tells the lecturers about the task, exam, and course times. It also tells the students to create personal reports. The evaluation was done in two stages: initial and experimental evaluations. The initial evaluation was to identify the need before the implementation of e-learning system design and to determine the demanded requirement by the students, lecturers, and content designers. It would facilitate them to determine the general requirement and provide descriptions about the aspects to consider than the other aspects. The notes were for the lecturers, students, content designers, and the technical device records in the department to ensure

the relevance with the system requirement. The experimental evaluation evaluated the e-learning system during the evaluation and testing stages.

B. The Characteristics of Science Learning in Online Learning Context

Online learning should be prepared effectively as the face-to-face classical learning does. Here are the online learning development (Moore, 2018 in Extension Engine Blog). There were ten excellent experience in developing the online learning.

1. Defining The Learners Personas

    Recognizing the learner candidates that will join the developed online learning. It was important to specify who would be the research targets, their previous educational background, their objectives joining the lessons, etc.

2. Defining The Learning Objectives

    Determining the learning objectives to achieve, the expected learning outcomes, the arrangement and the orders of the targeted objectives, and the stages to achieve the objectives.

3. Defining The Pedagogy Program

    It was important to determine the applied pedagogy whether it would be online or blended, or to determine certain theory to apply (for example, constructivist, connectives, etch).

4. Defining The Learner Experience

    It was important to determine the applied learning, for example the use of conference video, having

asynchronous nature or not, and accessibility on mobile device.

5. Defining The Learning Platform

    After finding out the activity and the applied pedagogy, then the researchers applied the *online learning platform* that would be used, for example the learning management system (LMS) and what device to use for supporting the learning.

6. Defining The Content

    It was important to determine the materials, to involve expert materials to develop the media, to determine what format the materials would be, and the interactivity, etc.

7. Defining The Assessment and Certification

    It was important to determine how learning outcome assessment would be done and whether the students would obtain certificate of accomplishment or not.

8. Defining The Operation Organization

    Determine what online course would it be (for the study program, faculty, etc). Determine who would take the responsibilities upon the learning operational facilities and what learning sources needed.

9. Defining The Support Service

    Identifying the given learning service for the lesson during the online learning besides the main matter.

10. Defining The Analytics

    The data analytic system geometry that could record the activities and learning outcomes.

Based on the practical items both the development and the online learning point development, the results showed relatively similar results. They were recognizing the learning candidates and their initial competencies, determining the learning objectives or competence, analyzing the competences to achieve the learning objective, applying the pedagogy and learning activity, determining the applied platform, developing the learning materials, determining the assessment system, developing the assessment materials, and developing the learning scenario or storyboard.

The online learning scenario is an outline of the online learning program that will be carried out. The developed learning scenario was based on *course blueprint.* In this learning scenario, all learning activity plans were realized so the paths and the connections among each other and the other parts of the activities could be done though detail manners.

The developed scenario for online learning:
1. Determining the learning process period whether it would be 4 weeks, 8 weeks, 12 weeks, 16 weeks, etc.
2. Based on the available time, map the study load for all courses proportionally into the learning activities for the period.
3. Determine the learning time and activities that were developed per discussion topic, including the time and the discussion topic to assess in term of formative learning outcomes or to provide tasks.
4. Determine the task provision whether it would be individual or collective, in the form of essay or the other, etc.

Table 1. The Science Online Learning Scenario Examples

Week	Discussion topic	Activities
1	Introduction Learning lesson orientation	Introduction by the lecturers and the course participants • Lecturers introduce via conference video • Asking the students to introduce briefly about their names, education backgrounds, jobs, purposes of studying, etc. Introducing the course • Giving the materials about the course introduction • Asking their hopes of this course • Explaining how the online course promotion plan was used, determining when to have synchronous and asynchronous meetings. • Explaining how the students accessed the course: tasks and final semester test, etc. Explaining that the tasks would be done in groups • Grouping the students into groups with the size of three until four individuals, asking them to get closer with their teammates.
2	Discussion Topic 1 Quantity and unit, measurement	• Delivering the discussion topic material about quantity and unit via video on the LMS • Having discussion via LMS • Giving tasks for the students to select the measurement device they found around their homes (rulers, stopwatch, balance) and measured an object with the measuring devices via video and upload it in the LMS • Evaluation via LMS
3	and so on	

The learning scenario was the reference to promote the online learning based on e-learning that was previously developed and used the applied platform.

C. Designing the Science Learning Practice in Online Learning Context

Laboratory is the core of many, science,courses. However, it is also the challenging element for the course to be effectively delivered from the distance (Kennepohl & Last, 1997). Experiment is considered as the foundation of education and raining for most scientists so the science learning program would need practical components to consider. Reasons to choose the practical works in science, teaching laboratory role, and the natures were changed. There had been many discussions and would be discussed more (Bennett & O'Neale, 1998; George, 2003; Lagowski, 2005). Various applied methods to handle the practice activities of online learning were (1) the supervised face-to-face sessions that were offered in a concentrated format at campus, regional location, or field; (2) the home-laboratory kit, (3) the experimental video demonstration, and (4) interactive computer simulation. There was not exact solution to provide laboratory for online learning. Thus, various methods were applied to deal with this challenge (Kennepohl & Last, 2000). However, some educators had directed their efforts to allow learners to access the factual experiment via internet.

Each laboratory type (real, virtual, and remote) had strengths and weaknesses (Nedic, Machotka & Nafalski, 2003). Laboratory for online learning was a bit advance than the virtual world and laboratory simulation produced by computer. They were the best alternatives for real laboratory

works. Although there were many variations to use it, the online learning teaching laboratory had four basic ways: 1) allowing natural phenomenon observation or experiment, 2) measuring, 3) manipulating the instrument or physics objects into the experiment, 4) facilitating, and the collaborative work from the distance.

There were two criticism about online learning laboratory. First, it was not perceived to offer identical laboratory environment with all its atmospheres, sounds, smells, and experience. Second, the students' interaction and the instructor-student interaction were changed or decreased.

The epistemological assumption based on these criticisms dealt with laboratory environment and human interaction were needed to provide effective laboratory experience for the students. "Laboratory environment and human interaction directed the formal and" informal learning. However, the other interaction forms could also influence the learning. Experience was proven not to have significant difference in terms of students' performance between the real practice mode and online learning practice (Ogot, Elliot & Glumac, 2003; Scanlon et al., 2004; Doulgeri & Matiakis, 2006; Fiore & Ratti, 2007). Laboratory used laboratory devices to obtain the learning outcomes that required skills. Therefore, the assessment should be postponed before being conducted. However, if the competence in using the device had been demonstrated in other places of the course even if the skill was still listed as the module learning outcome, the competence assessment could be ignored (Gamame, 2020).

Developing laboratory or practical component of a course required various factor considerations. Each

laboratory type (reality, virtual, or distance) offered benefits and limitations. Experiment should be made simple and firm. The physical space should be secured to store the experiments and to promote long-term maintenance, and to maintain the sustainable cost availability. The similar things were also applied of other laboratory components. The ones that should exist were clear visions, objectives, and learning outcomes for distant and developed experiments. Certain novelty level in the applied technology has the double-edge nature. At the beginning of the new model introduction, there would be Hawthorne effect. The laboratory designers, teachers, and learners had interests and usually responded positively at the beginning of the period. This effect, plus the realization of remote laboratory uses, brought amplification effects as identified by Lindsay & Good. The negative sides were damping effects that were caused by the hindering technology. The negative effects were the results of the technology focus than what had been supported by technology (Lindsay & Good, 2005).

Technology should not hinder the learning and all required things to carry out the experiment. It was perceived by learners to be a smooth, autonomous, and intuitive cites. Here are some online features to be developed in establishing the practices of online learning. 1) Public information that describe the projects and the researchers; 2) Password protection to limit the access into areas that may possibly be damaged; 3) Scheduling function to facilitate learners and instructors to apply the unique and safe instrument for the eligible operators; 4) Reachable FAQ as the "assistance part to overcome problems encountered by learners; 5) Tutorials to introduce the learners with the

software, tool, and certain experiment; 6) Stimulating experiment (in several cases) to conduct exercise; 7) Exercise for qualification to determine the minimum skill levels for students before moving to the real instrument access; 8) Access for actual distance to do real experiment; 9) Web cameras to show the instrument real-time during the experiment Objectives to make the instrument real for learners at distant learning (by seeing is trusting); 10) The connection to instructors and learners to deal with further problems and to provide moral support; 11) ELogbooksto for learners comment and list data at home that would be submitted from the experiment. It was useful to have easy handle on the large data collection. Thus, learners would not be drawn by the details; 12) The additional materials for each experiment, such as bibliography, reference, databases, or sources for revision (for example, the statistics preview) or useful links for other further studies; 13) Areas to send individual data and to take the collected data.

Conclusion

The ADDIE model is a scientific learning planning model in the context of online learning. It consists of five phases: analysis, design, development, implementation, and evaluation to preview and review themes.

The characteristics of science learning plan in online learning context are the learning process period, learning activities to do, discussion topics to assess, determining task provision method.

Designing the science learning practicum in online learning context needs consideration of many factors. Each laboratory type (reality, virtual, or distance) offered benefits

and limitations. Experiment should be made simple and firm. The physical space should be secured to store the experiments and to promote long-term maintenance, and to maintain the sustainable cost availability. Both the development, online science learning plan, and online science practice design should have clear visions about the objectives and the intended results. Thus, it was important to determine the pedagogy and the promoted activities as well as the applied platform.

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Online Pedagogical Assessment

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Abstract

Teacher pedagogical competence is the ability or skill of teachers who can manage a learning or teaching and learning interaction with students. One aspect of pedagogy is assessment. Assessment is carried out for the teaching and learning process, facilitating student learning and improving the quality of the teaching process. The assessment is carried out based on the learning objectives. The implementation of a technology-based assessment is called an online pedagogical assessment. This article provides an overview of the application of online assessment which can also be used as a reference. This research is a type of literature review. The data was obtained from article searches through Taylor & Farancis Online, Elsevier, Springer Link and Google Scholar portals in 2017-2021. The results of this study are the classification of online assessment types.

Keywords: Online Assessment, Types of Online Assessment, Online Pedagogical Assessment Strategies

Introduction

The development of technology and communication was initially carried out in lectures and used in the field of

education the learning process was transformed into virtual or online lessons." Both are ways to achieve predetermined learning outcomes. The graduates produced should have the same quality. The Indonesian Open and Integrated Online Learning Program (PDITT) is an example of change by the use of technology (Fitri, 2014). Online learning is rapidly evolving as a smart acronym and becoming the mainstream of education (Coates et al., 2020). Online learning is a topic that is often discussed by academics and students. The utilization of technology is used in assessing learning outcomes that are adapted to measuring tools and characteristics of online learning.

Assessment is an important part of life in schools between teachers and students. Various forms of assessment are commonly used by teachers to ensure that students get results after going through the learning process, such as providing information regarding progress in their studies. Assessments held online changed the initial paradigm of teachers related to the use of technology (Faizah et al., 2021). Online learning requires teachers to master technology. One of the places to carry out online learning using a platform. Online learning platforms present many opportunities to assess student learning progress (Anderson, 2008). There are various types of platforms developed, both asynchronously and synchronously, such as discussion forums and short messages to facilitate instruction from teachers. The use of platforms that are used by filling in sources of teaching materials that are in accordance with the objectives of learning outcomes has been proven to improve students' knowledge and skills (Pei & Wu, 2019). This was revealed through a comparative study between offline and online

learning based on internet usage. The grouping of online assessments is divided into three which include, differences based on internet use, based on the use of gadgets, and based on the pattern followed (Vijayalakshmi, 2020). This was revealed through a comparative study between offline and online learning based on internet usage. The grouping of online assessments is divided into three which include, differences based on internet use, based on the use of gadgets, and based on the pattern followed (Vijayalakshmi, 2020). This was revealed through a comparative study between offline and online learning based on internet usage. The grouping of online assessments is divided into three which include, differences based on internet use, based on the use of gadgets, and based on the pattern followed (Vijayalakshmi, 2020).

The internet is one of the means to support the implementation of online learning, besides that there are differences in assessment based on the use of gadgets, namely Computer Assisted Assessment (CAA) and Computer-Based Assessment (CBA). CAA is a computer application for the assessment process, including test delivery, response capture and marking by either computer or human markers. CAA aims to make students more critical and confident in solving problems (Putri, 2019). CAA can be used at any stage of the assessment process. While CBA is an assessment that is delivered and marked through a computer. The difference between CAA and CBA is the use of computers which are only used as part of the assessment process. CBA can be used for summative, formative or diagnostic assessment purposes, with or without feedback automatically. CBA is based on multiple-choice questions

(multiple-choice questions) or other types of 'objective' questions, although non-objective questions (e.g. essays, short answers) may also be included (Nottingham Trent University). The purpose of the diagnostic assessment, formative, summative, norm reference, and referred criteria is one of the differences in assessment based on the pattern followed.

Online assessment is related to the instrument used, it raises various online pedagogical assessment strategies. The use of online assessment has advantages and disadvantages from different points of view.

Method

This research is a literature review. The literature review includes research that discusses the grouping of online assessments which includes three things, strategies for using online assessments and the advantages and disadvantages of using online assessments. To investigate this study, we conducted a search of articles through Taylor & Farancis Online, Elsevier, Springer Link and Google Scholar in 2017-2021 relating to grouping, usage strategies and advantages and disadvantages of using online assessment. In this article, we first define the meaning of online assessment. Second, we determine the grouping of online assessments based on internet usage use of gadgets and the pattern followed. Third, look for keywords related to online assessment strategies which include the use of instruments. Fourth, analyze the advantages and disadvantages of using online assessments. Thus, articles can be presented that can be used as references using various online assessments.

Results and Discussion

A. Definition of Online Assessment

According to Hanna (1993): Evaluation is the process of collecting, interpreting, and synthesizing information to support decision-making. Evaluation is measurement and observation. Evaluation is the drawing of conclusions from these data sources. Terminology Assessment refers to the various methods or tools that educators use to assess, measure, and document a student's readiness to learn, learning progress, skill acquisition, or educational needs. It changed the way assessments are handled from pencil and paper (traditional) to technology-based online assessment (Education Reform Glossary). Evaluation is the process of collecting, interpreting, summarizing and making decisions. The evaluation decision-making process is based on the data obtained from the measurement results (in the form of quantitative data) and the qualitative data obtained from the observations. The definition of assessment is also given by Harlen (2006) which states that assessment in the context of education is a process of collecting evidence and making judgments to make decisions about student learning outcomes related to the learning objectives to be measured. Online assessment is a process evaluate, measure and document educators do to make decisions related to learning processes and outcomes through online learning.

The main purpose of assessment is more focused on efforts to improve student's learning and student learning development rather than just determining student learning outcomes as stated by Morgan & O'Reilly (1999): The primary purpose of assessment is to increase student's learning and development rather than simply to grade or

rank student performance. Assessment in learning can be carried out in various ways and purposes, but according to William & Leahy (2007) in general assessment has three functions: 1) helping to improve learning, 2) determining student learning outcomes, and 3) evaluating the quality of learning programs.

B. Types of Online Assessment

The online assessment is grouped into three based on internet use, use of gadgets, the pattern followed. Table 1 shows the classification of the types of assessments.

Table 1. Grouping the types of online assessments

No	Internet usage	Use of gadgets	Pattern to follow
1	Online assessment	Computer Assisted Assessment	Diagnostic assessment
2	offline assessment	Computer-Based Assessment	Formative Assessment
3	-	-	Summative assessment

The following is a more detailed discussion regarding comparisons based on internet use between online assessments and offline assessments, which can be seen in Table 2.

Table 2. Table of online assessment grouping based on internet usage

No	Author	Title
1	Hope, et al. (2021)	Candidates undertaking (invigilated) assessment online show no differences in performance compared to those undertaking assessment offline
2	Pei & Wu (2019)	Does online learning work better than offline learning in undergraduate medical

		education? A systematic review and meta-analysis.
3	Zhang, et al. (2017)	Survey method matters: Online/offline questionnaires and face-to-face or telephone interviews differ.
4	Garcia, et al. (2021)	Recommendations for Mandatory Online Assessment in Higher Education During the COVID-19 Pandemic.
5	Rahimi, et al. (2017)	Effects of offline vs. online digital storytelling on the development of EFL learners' literacy skills.

Situations and conditions that allow a transition such as the COVID-19 pandemic era from using offline assessments to online assessments do not effect on student performance (Hope, et al. 2021). This is also shown by research (Garcia, et al. 2021) regarding the transition to how to carry out assessments in the learning process. Comparison when conducting online and offline assessments can be concluded that offline assessments have not been proven to improve student performance. However, in reality online learning assessment has the advantage of increasing students' knowledge and skills, and is considered a potential way (Pei & Wu, 2019). The use of online platforms is proven to be better than the content provided online, this is evidenced by the results of the assessment that literacy skills improve better, then the number of working hours applied to online platforms can improve performance and literacy skills Rahimi, et al. (2017). However, research by Zhang, et al. (2017) stated that the provision of online and offline assessments had statistically significant differences due to differences in the age of respondents.

Furthermore, the grouping of online assessments based on the use of gadgets can be seen in table 3.

Table 3. Table for grouping online assessments based on the use of gadgets

No	Author	Title
1	Detey, et al (2020)	Computer-assisted assessment of phonetic fluency in a second language: a longitudinal study of Japanese learners of French.
2	Bahari, et al (2021)	Computer-assisted language proficiency assessment tools and strategies.
3	Rutkowski, et al (2017)	Information Channel Based Measure of Effectiveness of Computer-Assisted Assessment in Flipped Classroom.
4	Fishbein, et al. 2019	The TIMSS 2019 item equivalence study: Examining mode effects for computer-based assessment and implications for measuring trends.
5	Rim & Jung (2017)	Comparative Analysis of Influential Factors on Computer-Based Mathematics Assessment between Korea and Singapore.
6	Cagiltay, et al (2018)	Construct and face validity of the educational computer-based environment (ECE) assessment scenarios for basic endoneurosurgery skills.

Furthermore, the use of CAA is used to develop computer-aided pronunciation training tools. In addition, the practice of using CAA can help carry out online assessments (Rutkowski, et al, 2017). The existence of CAA helps develop an assessment that can assess speech speed, regularity of speech speed but is unable to detect fluency of speech (Detey, et al 2020; Bahari, et al 2021). The following is a table of assessment stages and examples of CAA which can be seen in table 4.

Table 4. Table of assessment stages and examples of CAA

No	Stages	Example
1	Supporting students in using assessment	• Facilitate discussion with my students on assessment and criteria • Provide students with previous exam papers or other assessment information
2	Assessment process	• Assessing online collaboration activities • Assessing student progress over time
3	Tagging and feedback	Students submit electronic assessments
4	Recording	Storing and retrieving electronic bookmarks
5	Reciprocity to students	Facilitate peer or tutor feedback

(Source: Nottingham Trent University)

The use of CBA is used as an eTIMSS assessment, an experiment given to a number of students around the world that the use of paper assessments is considered easier than eTIMSS because the many digital formats make students confused (Fishbein et al., 2019). The use of ICT at home for schoolwork is related attitudes towards computers as learning aids in schools, and openness and persistence in problem-solving were positively related to computer-based mathematics performance, whereas the use of ICT in mathematics classrooms by teacher demonstrations was negatively related (Rim & Jung, 2017). The virtual reality simulator improves the education and evaluation of neurosurgery programs and provides an alternative that allows multiple measures of objective evaluations without the need for numerous tools to assess the overall performance of students. The balance between cognitive and surgical skills is important for better design and development of surgical simulation tools for skill assessment (Cagiltay et al., 2018). The

following table shows the reasons for using and the benefits of CBA which can be seen in table 5.

Table 5. Table of uses and benefits of CBA

No	Stages	Example
1	Provide additional diagnostic or formative assessment opportunities.	Detailed feedback can be incorporated into the CBA assessment, whether the primary focus is diagnostic, formative, or summative.
2	Give timely feedback	Feedback can be delivered immediately and/or automatically. This can be very useful for formative use.
3	Tag jobs quickly	Tests are marked automatically and consistently by the computer.
4	Increase the flexibility of delivering assessments	The CBA test can be done anytime, anywhere. The duration of the test, the assessment period available and the number of attempts allowed can all vary.
5	Test all my students but also vary the order of the questions to encourage them to work individually	The question library (e.g. for the NOW assessment tool) allows the order of questions to be randomized if desired.
6	Create a set of questions to use and reuse across multiple assessments	Question libraries (e.g. for the NOW assessment tool) can be copied in a number of study rooms. Therefore, the task of creating a question bank can be divided across modules or course teams to maximize efficiency.

(Source: Nottingham Trent University)

Furthermore, the grouping of online assessments based on the pattern followed can be seen in table 6.

Table 6. Online assessment grouping table based
on the pattern followed

No	Author	Title
1	Kruit, et al. (2020)	Performance Assessment as a Diagnostic Tool for Science Teachers. Research in Science Education.
2	Molnár & Csapó, (2019).	Technology-based diagnostic assessments for identifying early mathematical learning difficulties.
3	Acosta-Gonzaga & Swallow, (2018).	The role of attitudinal factors in mathematical online assessments: a study of undergraduate STEM students.
4	Sewell, et al. (2010)	Online assessment strategies: A primer
5	Perera-Diltz, et al. (2014)	Formative and Summative Assessment in Online Education.

The following model-based online assessments include diagnostics, sums, and formative assessments. Diagnostic evaluation is an evaluation aimed at clarifying the weaknesses and factors of students (Suwarto, 2012). The implementation of this kind of assessment usually aims for the purposes of tutoring, remedial teaching, finding cases and others. An example of the use of diagnostic assessment developed in performance assessment. The conclusion that performance appraisal can be used as a diagnostic tool to monitor student achievement and help teachers assess and improve science education (Kruit et al., 2020). One of the difficulties faced by teachers in transferring mathematical knowledge was discussed by.

Popham (2009) defines formative assessment as a planned process in which evidence about student learning conditions is used by teachers to make adjustments to ongoing learning or also used by students to adjust their learning techniques. There are several factors that play a role

in formative assessment, attitude and enjoyment are factors that influence students' intention to use online assessment. Students are motivated to use technology assessment effectively. Summative assessment is carried out at the end of the learning program. Through summative assessment, you can find out how the picture of the quality of learning as a whole is.

Accessing online assessments influences usability and contributes to a strong indirect effect on attitudes and usage intentions (Acosta-Gonzaga & Swallow, 2018). Assessment Both formative (developmental) and summative (final) classroom learning are suitable for online learning (Sewell et al., 2010). In addition, to comprehensively evaluate online and online training practices, you must understand the unique characteristics and tools of electronic media. "Evaluating both formative and holistic online learning also requires the application of constructivist learning principles to a shared understanding of the educational process and related goals (Perera-Diltz et al.. 2014).

C. Online Pedagogical Assessment Strategy

Online assessments can be applied with a variety of instruments, where there is one platform that is used as a forum for designing online assessments, namely http://help.blackboard.com. The online assessment strategy implemented according to Vijayalakshmi (2020) Multiple-choice, either/or quiz questions, short answers, essay-type questions, file-answer questions, quiz questions, question order, blank as well as sensitive questions, jumbled Includes text, drop-down lists, communications, drag-and-drop, drag-and-drop markup questions, listening, and fluency.

D. Advantages and Disadvantages of Online Assessment

After being studied through some literature, it can be seen the advantages and disadvantages when implementing online learning assessments can be seen in table 7.

Table 7. Table of grouping advantages and disadvantages of online assessment

No	Advantages	Disadvantages
1	Online assessments are highly interactive, customizable, trustworthy, secure and accessible across a wide range of device	Students must be computer literate to take the assessment
2	Evaluation and assessment are very easy. Save time and money.	There may be a problem with the Internet and its connectivity
3	Multiple candidates can attend the online assessment at the same time	Online assessment software is too expensive
4	Students can take the assessment anytime, anywhere.	
5	Get their results, answers and feedback immediately on their chosen topic	
6	Cheating and fraud are eliminated in online assessment	

Conclusion

After conducting a literature review on online pedagogical assessment, it can be concluded that.

1. Online pedagogical assessment is the process of evaluating, measuring and documenting educators to make decisions related to learning processes and outcomes through online learning.

2. The grouping of online assessments is based on three things, namely the use of the internet (online and offline assessments), the use of gadgets (CAA and CAB), and

the pattern followed (diagnostic, formative, and summative assessments).

3. The strategy for implementing the online assessment consists of: multiple-choice questions, either/or questions, short answers, essay type questions, file response questions, quiz bowl questions, ordering questions, fill in the blanks and fill in multiple blanks, hot spot questions, jumbled sentences, drop-down, matching, drag and drop, drag and drop markers questions, listening comprehension, proficiency.

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Selection of Online Learning Media Platform in Indonesia

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Abstract

The purpose of this critical review is to analyze and provide identification related to online learning media platforms in Indonesia during the COVID-19 pandemic. This critical review study specifically aims to answer descriptively regarding four things, namely: (1) analyzing and defining MOOC, (2) identifying the types of platforms that are generally used in online learning in Indonesia, (3) identifying the different platforms used in learning. online at the primary, secondary and tertiary education levels, 4) identify the advantages and disadvantages of LMS (Google Classroom, Moodle and Edmodo and (5) identify related to the development of online learning platforms in schools so that they can be used as a reference in the implementation of subsequent learning activities. The method used in this research is literature study from several national and international journals. The first thing the researcher did was to provide a definition of online-based learning and the media it uses. The second step is to find and classify information from journals and books that discuss the platform and the media it uses. The final step is to carry out the process of identification, analysis, and synthesis of the information that has been obtained into a study that can be

accounted for so that it is valuable in education policy making.

Keywords: Platform, Media, Online Learning in Indonesia

Introduction

The era of disruption is a challenge for educators, where the role of humans is gradually being replaced by machines so that educators inevitably need to welcome this era by becoming a disruptive educator. Self-development with innovation and renewal is very important for educators to adapt (Setiawan & Komalasari, 2020). Technology plays an important role in supporting education which can promote understanding. In this digital age, every activity/life uses technology. This can be seen in the evolution of Industry 4.0, which allows easy access to all the information you need, especially in the world of training. Digitization of education is achieved in Indonesia by expanding e-learning (online). By observing online learning, you will be able to access it quickly and easily from anywhere. In early 2020, the world was rocked by the 2019 coronavirus (COVID-19) outbreak and changed education and learning in the world of education. This uses e-learning (online) to quickly change face-to-face operations and prevent the rapid spread of COVID-19.

Many anomalous policies adopted by many heads of state around the world such as closing schools, places of worship and tourist attractions still failed to prevent the spread of the virus, forcing the state to apply policies. more extreme. This is called containment or closure of this territory (Iin, 2020). At the beginning of 2020 the world was

shocked by the spread of the Corona Virus Disease 2019 (COVID-19) outbreak, which resulted in a change in teaching and learning in the world of education. This makes face-to-face activities change quickly using online learning (online) to prevent the rapid transmission of COVID-19. A number of unusual policies taken by a number of heads of state in the world, such as closing schools, houses of worship, tourist places, but still this virus cannot be stopped from spreading, the state is forced to take even more extreme policies, namely closing its territory, or what is called with lock down (Iin, 2020). At the beginning of 2020 the world was shocked by the spread of the Corona Virus Disease 2019 (COVID-19) outbreak, which resulted in a change in teaching and learning in the world of education. This makes face-to-face activities change quickly using online learning (online) to prevent the rapid transmission of COVID-19. A number of unusual policies taken by a number of heads of state in the world, such as closing schools, houses of worship, tourist places, but still this virus cannot be stopped from spreading, the state is forced to take even more extreme policies, namely closing its territory, or what is called with lock down (Iin, 2020). This makes face-to-face activities change quickly using online learning (online) to prevent the rapid transmission of COVID-19. A number of unusual policies taken by a number of heads of state in the world, such as closing schools, houses of worship, tourist places, but still this virus cannot be stopped from spreading with lock down (Iin, 2020). This makes face-to-face activities change quickly using online learning (online) to prevent the rapid transmission of COVID-19. Several unusual policies taken by a number of heads of state in the world, such as closing schools, houses of

worship, tourist places, but still this virus cannot be stopped from spreading, the state is forced to take even more extreme policies, namely closing its territory, or what is called with lock down (Iin, 2020).

Choosing the right platform for learning during a pandemic can produce good outputs in accordance with existing needs and conditions. Virtual/online/online learning that is currently being demanded can use online media. Online learning is expected not to cause boredom, boredom from both educators and students, so that in conditions of learning from home it will still produce a superior generation (Indiani, 2020). Online learning was chosen as an alternative to distance learning to reduce the potential for the spread of the virus. However, there are doubts about the effectiveness of online-based learning in the learning process (Setiawan & Komalasari, 2020). The massive spread of COVID-19 has impacted teaching and learning activities, for academics, a serious concern in the online learning process is a real program for handling acute crisis management during the COVID-19 pandemic. Handling during this crisis is not only applied to government, private or educational institutions, but to all companies.

There are many choices of online learning media, ranging from just sending messages (chatting) to media that can display videos or conduct video conferences. All online class platforms offer various interesting features and are able to facilitate online learning (Hidayat & Noeraida, 2020). Online learning media that can be used today are through the Whatsapp application, e-learning, Whatsapp group, goggle classroom, virtual class, email, telegram, google form, zoom, Meet, Webex Meet and others (Indiani, 2020). Online

learning is for the most part a new and unplanned learning method. This situation happened a little forced due to the COVID-19 pandemic (Hidayat & Noeraida, 2020).

Online learning has different technicalities from the face-to-face system learning model which is carried out with full online learning and makes it easier to access it anywhere. This relies on the internet as the pace of lectures which not only makes it easier for lecturers and students in determining communication models for the implementation of learning. Online learning activities that take place in real time make educators choose the right application for continuous learning (Maulah et al., 2020).

Constraints faced during the implementation of learning do not rule out the possibility that online learning at home experienced by students makes learning ineffective. The problems that occur include the lack of a network, data packages (Internet quota), the availability of learning devices (laptops, smartphones), the home atmosphere and the unsupportive environment also determine the effectiveness of online learning. The biggest difficulty experienced by students is the level of understanding of the material, because the learning style of each student affects the level of understanding in the absorption of learning material (Maulah et al., 2020). Therefore, there is a need to analyze which learning media platforms are effective and all students can support e-learning during the new normal.

The purpose of literature research with the major theme of choosing an online learning platform in Indonesia is to get a general picture, so that in the future a further study can be carried out regarding how a strategic policy implements and chooses an effective and efficient platform in the learning

process in Indonesia. This literature review was conducted to conduct an investigation regarding the platforms used during online learning due to the effects of the COVID-19 pandemic. The variety of platforms used by educational units from elementary, secondary to tertiary levels is the basis for researchers in making a study about what types of learning platforms are used in Indonesia during the COVID-19 pandemic. In the analysis of this review article.

1. What are Massive Open Online Courses (MOOC)?
2. What types of platforms are generally used in online learning in Indonesia?
3. How are the different platforms used in online learning at the primary, secondary and tertiary education levels?
4. What are the advantages and disadvantages of LMS (Google Classroom, Moodle and Edmodo)?
5. How to develop an online learning platform in schools?

Method

Types of surveys used to provide information on the types of platforms commonly used in online learning and to learn about the differences between the platforms used in online learning between high school and college students. This is an important review. It can be used as a reference in other learning activities. The backbone of online learning in this study focuses on the use of learning platforms in Internet services. Analysis of the data in this study using the analysis model of Miles & Huberman (1994) which consists of three stages, namely data reduction, data display, and drawing and conclusions.

This literature review specifically aims to answer descriptively regarding four things, namely: (1) analyzing

and defining MOOC, (2) identifying the types of platforms that are generally used in online learning in Indonesia, (3) identifying the different platforms used in learning online at the primary, secondary and tertiary education levels, (4) identify the advantages and disadvantages of LMS (Google Classroom, Moodle and Edmodo, and (5) identify related to the development of online learning platforms in schools.

Results and Discussion
A. Massive Open Online Courses (MOOC)

The academic education of massive open online courses (MOOC) began in 2008, but three years later Stanford University in the United States launched three courses, bringing together thousands of students from many countries around the world. A year later, in 2012, significant progress was made in this area, when venture capital funds began to invest heavily in companies run by MOOC. Since then, it has become a central topic in the academic and public debate on higher education (McAuley, Stewart, Siemens, & Cormier, 2010; Cho, 2012; Waldrop, 2013).

On this basis, many studies have investigated the effectiveness and different effects of this innovative teaching method. (McKnight, 2006; Kim & Bonk, 2006; Keohane, 2013; Deming, Goldin, Katz, & Yuchtman, 2015). Some explored the satisfaction of academic faculty members with online teaching methods (Bolliger & Wasilik, 2009; Baran, Correia, & Thompson, 2013). Others focus on the barriers to online teaching and the role of faculty in innovative learning environments (Shea, Pickett, & Li, 2005; Keengwe & Kidd, 2010) as well as the challenges it poses for them (Bennett & Lockyer, 2004; Bourne & Bacsich, 2009; Bonvillian & Singer,

2013; Kebritchi, Lipschuetz, & Santiague, 2017), while others focus on student satisfaction with the expansion of online teaching.

In today's world of work, a bachelor's degree is increasingly required as a prerequisite for employment, and in fact, in recent years, a large part of the world's population has attended university (Bach, Haynes, & Smith, 2007). At the same time, this era is characterized by excellent use of the screen for viewing video clips and photos. These two trends are closely linked and make the adoption of online teaching methods a natural and obvious process. As a result, many transfer courses have been implemented, moving from face-to-face education to online education (Pitt, 2016). The transition from traditional teaching to innovative teaching generally requires academics, especially teachers, to carefully plan their activities, assignments and methods of evaluation.

1. MOOC Application Opportunities in Indonesia

According to Santoso (2018) there are seven opportunities for MOOC implementation in Indonesia. The seven opportunities can be seen in table 1.

The Indonesian government helps educational institutions to implement MOOC. This support is described in Ministerial Regulation no. 109, 2013, regulating the implementation of distance learning in universities (Minister of Education Regulation, 2013). This rule also ensures the distance at which education participants can earn academic credits granted by the promoter. This means that MOOCs have the potential to link Indonesia's informal and formal education. This is an opportunity for Indonesia to increase student enrollment in higher education.

Table 1. Opportunities for MOOC implementation
in Indonesia

Code	Opportunities	References
[OP01]	Indonesia has many potential MOOC students.	(Internet World Stats, 2016),
[OP02]	Government supports MOOCs through Presidential and Ministerial Regulations.	(APJII, 2016),
[OP03]	MOOCs have the potential to connect the nonformal and formal education in Indonesia.	Respondent quotes [P2], [P5], [P7], & [P8]
[OP04]	MOOCs can be used as promotional tools by the university to attract potential students.	(Ministerial Regulation, 2013)
[OP05]	Quality and equity in education are needed to improve the standard of living of Indonesians.	(Ministerial Regulation, 2013),
[OP06]	Accessibility of qualified training is needed to improve professional skills.	Respondent quotes [P3] & [P4]
[OP07]	There are only a few MOOC providers in Indonesia, so the competition level is low.	Observation on local MOOCs, Respondent quotes [P5]

Source: Santoso, HB (2018)

2. MOOC Implementation Challenges in Indonesia

The success or failure of a MOOC depends on its content. Content development in MOOC, which in this case is a course, is expensive and not an easy task. Holland and Tirthali (2014) in their study stated that the cost needed to create an MOOC was around $38,908 to $325,330. In addition, the Study file also explains that the main cost drivers in the production and delivery of MOOCs are the number of faculty members, administrators, and instructional support personnel who participate in the process; it's videographic quality; the nature of the delivery of the platform; programming for special features, such as computer code autograders, virtual laboratories, simulations, or gamification; platform data analysis; and technical support for participants (Hollands & Tirthali, 2014).

The course development process is not only expensive, but also time-consuming (Holland and Tirthali, 2014) assert that the effort to create a MOOC is two to three times greater than creating a traditional course. To create an hour's worth of MOOC videos, lecturers need three to ten hours of preparation. Sustainability, especially in finance and content, also makes believing that implementing MOOC in Indonesia is a challenge. In short, MOOC development takes a lot of time and money.

According to Santoso, HB (2018) there are seven challenges in implementing MOOC in Indonesia. The seven opportunities can be seen in table 2.

Table 2. Challenges of MOOC implementation in Indonesia

Code	Challenges (Threats)	References
[CH01]	There are only a few Internet users outside Java island.	(APJII, 2016), (Puskakom UI, 2015), Respondent quotes [P1] & [P6]
[CH02]	Digital literacy in Indonesia is still low.	(Internet World Stats, 2016), (APJII, 2016), (Puskakom UI, 2015), (Mirani, 2015), (Geopoll, 2015), Respondent quotes [P3], [P6], & [P7]
[CH03]	Obligations that are regulated by the Indonesian government need to be fulfilled.	(Ministerial Regulation, 2013), Respondent quotes [P8]
[CH04]	Course development in MOOC requires a lot of time and money.	Respondent quotes [P1] & [P2]
[CH05]	Multidisciplinary knowledge and skills are required to make qualified courses.	Respondent quotes [P1], [P3], & [P4] (Ministerial Regulation, 2013)
[CH06]	English skills of Indonesians are still at a low to medium level.	(EF Education First, 2016)
[CH07]	There is no mature business model for MOOCs in Indonesia yet.	Observation on local MOOCs, Respondent quotes [P2], [P4], [P7], [P8]

Source: Santoso, HB (2018)

3. Indonesian MOOC Providers

IndonesiaX is the first MOOC we found and has 17 active courses. We consider IndonesiaX to be the largest

MOOC in Indonesia in terms of courses and partnerships. Various course topics are offered by IndonesiaX, such as: business, management, engineering, information technology, and law. This provider also has partnerships with several well-known universities in Indonesia. They provide open courses on the Indonesian MOOC platform.

In table 3, there are at least four MOOC service providers in Indonesia with various types of service topics.

Table 3. Indonesian MOOC providers

No	MOOC	Active Courses	Established	Course Topic
1	IndonesiaX (https://www.indonesiax.co.id/)	17	2015	Management, Information Technology, Business, Engineering, Law
2	MOOC UT (http://moocs.ut.ac.id/)	7	2015	General Topic, Information Technology
3	UCEO (https://ciputrauceo.com/)	12	2013	Entrepreneur
4	FOCUS Fisipol UGM (http://focus.fisipol.ugm.ac.id/)	12	2016	Social and Political Sciences

Source: Santoso, HB (2018)

The two MOOC providers are MOOC Open Universities. We only offer 7 courses that work on a common theme. The three MOOCs are the Ciputra Online University Entrepreneurship Agency (UCEO). They focus on entrepreneurship topics in 12 active courses. The vendor's latest MOOC is the FOCUS of the Faculty of Social Political Science (FISPOL) at Gadjah Mada University. They have 12 courses dealing with specific topics in social and political science.

There are some interesting things reflected in the current state of MOOCs in Indonesia. First of all, the MOOC files currently available in Indonesia are not very large. A study by Shrader et al. (2016) Please note that 8 week courses have 10,000-100,000 registrations and we believe there are overwhelming numbers. On the other hand, on the Indonesian MOOC platform, we did not know that there were more than 1,000 registrations per course. In addition, very few people participated in the discussion of every MOOC that we observed. Based on this, we conclude that the number of MOOC participants in Indonesia is unlikely to be large. Courses are also provided to demonstrate that all MOOC providers observed are small. However, after the investigation, it was found that the current state of MOOCs in Indonesia was both an opportunity and a problem. We see an opportunity to have a small number of MOOCs available in Indonesia. This means that the level of competition among MOOC providers is low. On the other hand, Indonesia does not have a mature MOOC business model. This is also a challenge for organizations wishing to implement MOOCs.

Marketing is one of the key business activities that plays an important role in the success of MOOCs, and according to previous respondents, the opinion of Indonesian MOOC suppliers is the lack of promotion. On the other hand, most people in Indonesia are unaware that MOOCs exist. Marketing is necessary for a successful MOOC. In addition, MOOC providers need to work hard to get students and teachers to use MOOCs. Before requesting registration, you need to inform the user about the MOOC.

B. Types of Platforms Commonly Used in Online Learning in Indonesia

Online learning activities are basically not much different from face-to-face activities. Online learning has its own challenges and obstacles in the process due to Indonesia's diverse geographical conditions, resulting in different digital/online learning treatments (Yermiandhoko et. al, 2020). In line with Milman (2015) Digital technology allows students and teachers to complete the learning process even when they are in different locations. According to Moore et al. (2011) explained that e-learning is learning over the Internet with access, connectivity, flexibility, and the ability to establish different types of learning interactions. Basically, online e-learning connects students to physically isolated learning resources. These resources can communicate, interact, or collaborate with each other (direct/synchronous and indirect/asynchronous). E-learning is a form of distance learning that uses information and communication technologies such as the Internet and CDROOM (Molinda, 2005).

The concept of online learning is learning that aims to reach massive and broad groups by utilizing the internet network (Yanti et al., 2020). Basically, e-learning activities take advantage of technological advancements such as multimedia technology, video, virtual classrooms, dynamic online text, voicemail, email, conference calls and video transmission. E-learning can be mass produced for an unlimited number of participants and can be done for free or for a fee (Bilfaqih & Qomarudin, 2015).

In online learning, the terms synchronous and asynchronous are known. The term synchronous is a learning

activity that requires all elements, both teachers and students, to interact together in a specified time. The learning aspect used in online-based activities is in the form of a teleconference using an audio-visual display so that it requires a large bandwidth (network bandwidth). Remote service provider platforms directly by utilizing video conferencing services include Zoom, Cisco WebEx, Google Hangouts Meet, Skype, Join.me, and many more. In line with Korucu & Alkan (2011) stated that in online learning, mobile technology has a major contribution in educational institutions, including the achievement of distance learning goals.

Platforms Online learning allows teachers to carry out learning such as conducting remote presentations and discussing with students. By using this platform, students can ask questions directly. In addition, teachers can also directly provide feedback to their students. Asynchronous is a form of learning activity that is not synchronous/face-to-face online with non-concurrent interactions between learning elements. The implementation time of the activity may vary depending on the agreement between the students or the teacher. These activities include reading material, doing assignments, and sending assignments.

Platforms media that support the implementation of online learning for example virtual classes using Google Classroom, Edmodo, and Schoology services (Enriquez, 2014; Sicat, 2015; Iftakhar, 2016). In line with So (2016) regarding the use of instant messaging applications such as Whatsapp. In addition, research from Kumar & Nanda (2018) states that online learning can be done through social media such as Facebook and Instagram.

Basically, the online learning platform uses the concept of learning management system/LMS or often called e-learning. There are e-learning sites that can be used freely and free of charge, and some are paid and have binding conditions for their use. Broadly speaking, the features in the LMS are divided into 2, namely features of synchronous learning activities (synchronous), and features of asynchronous learning activities (asynchronous). This is the basis for using different platforms between an agency, both in the primary, secondary and tertiary education circles. In line with Mirzon et. at. (2020) stated that the digital platform is a program that can support the success of online learning.

Assidiqi & Sumarni (2020) explained that there are three digital platforms that are often used, namely Whatsapp groups, Google Facilities (Google Classroom, Google Forms, and Google meet) and Zoom Cloud Meetings. In line with Handarini and Wulandari (2020) stating that the government also takes a role in addressing inequality in learning activities during the COVID-19 pandemic by providing 12 platforms or applications that students can access to study at home, namely (1) learning houses; (2) Our table; (3) Icando; (4) Indonesiax; (5) Google for education; (6) Smart class; (7) Microsoft office 365; (8) Quipper school (9) Teacher's room; (10) Your school; (11) Zenius; (12) Cisco webex. The following is presented in table 4 of the analysis related to the types of platforms found in national and international journals as follows.

Table 4. Results of journal analysis related to the platform
online learning in indonesia

Category	Domestic Journal
Platforms used in learning	1)Whatsapp; 2) Lines; 3) Google Classroom; 4) Youtube; 5) Zoom; 6) Google Meet; 7) Instagram; 9) Moodle; 10) Homemade e-learning application; 11) Zeniu; 12) Study house; 13) Edmodo; 14) M-education; 15) Teacher's room; 16) Quippers; 17) Your school; 18) Google Suite for Education; 19) Microsoft Office 365 for Education; 20) Icando; 21) Cisco webex; 22) Our table; 23) Indonesiax

The analysis of the use of online learning media platforms in Indonesia is generally based on a point of consideration for its use, namely the level of effectiveness and efficiency. Derivatives from these categories are based on function (live), and quota considerations. In detail, it can be explained that the selection of online learning platforms includes the categories of designation, among others based on the type of application which includes 1) Whatsapp; 2) Lines; 3) Google Classroom; 4) Other supported applications. Meanwhile, for the purposes of Live, learning activities in Indonesia generally use the following platforms: 1) Line; 2) Youtube; 3) Zoom; 4) Google Meet; 4) Whatsapp; 5) Instagram and 6) Google Classroom. The next thing that makes a consideration is the minimum quota that must be issued by the user, in this case grouped based on the minimum quota that is considered efficient in its use, namely: 1) Whatsapp; 2) Lines; 3) Google Classroom; 4) Moodle and 5) Other apps.

The emergence of diversity in the use of media platforms in online learning is basically aimed at minimizing negative aspects in the learning process. As explained in Szpunar, Moulton, & Schacter, (2013) that students fantasize more often in online lectures than in face-to-face lectures. So it is highly recommended that online learning activities only take a few hours to carry out, the rest are more asynchronous activities that are projects or assignments. It is explained in Khan (2012) Online learning should be done in a short period of time, as it will be difficult to maintain concentration if the online classes are longer than an hour.

C. Differences in Platforms Used in Online Learning at Elementary, Middle and Higher Education Levels

The challenges and obstacles to online learning are mainly geographical conditions, especially in remote areas and do not have good internet access, so that the implementation of online learning shows a different trend. That is the fundamental difference in the use of platforms in online learning from an educational institution, be it secondary or higher education. The solution offered regarding these problems is that students look for certain areas such as hills and sub-districts to be affordable by internet access. Of course, these factors are the same cause between basic, secondary and higher education levels that lead to the use of different platforms. In line with Hasanah, et al. (2020) stated that online learning also has challenges related to the availability of internet networks. Some admitted that it was difficult to participate in online learning because not all areas had internet access with smooth access. This is also the background why each educational institution

in various parts of Indonesia is different in the use of online learning media platforms.

Sari et al. (2019) stated thatdistance learning for elementary school students through guidance from parents at home by using several learning applications such as Whatsapp groups, classroom, via zoom, and many other applications. Supported by researchAssidiqi and Sumarni (2020) stated that the most frequently used digital platforms in online learning at the elementary level include Whatsapp groups, Google Facilities (Google Classroom, Google Form, and Google meet) and Zoom Cloud Meetings. At the elementary learning level (SD) students tend to be passive, so in this case the role of parents is vital in the online learning process because parents must understand the material before teaching it to their children. In addition, the various conditions and backgrounds of elementary school students' parents cause the use of online learning media to be simple so that they become more effective in the process of helping learning activities. Using Whatsapp groups is simpler and easier to use. Teachers can send various things such as materials, evaluation questions, and explanations via video or voice notes. Whatsapp groups are also able to facilitate two-way learning through video call services. The lack of use of Zoom is due to the limitations and mastery of parental technology and requires a strong network to use it.

Handarini & Wulandari (2020) explained that for the secondary education level, in this case, Vocational High Schools are in the learning process using Whatsapp, video conferencing, google forms, or through available special applications. This is considered effective because to conduct online learning, adequate facilities and infrastructure are

needed, such as internet networks, smartphones, laptops and computers. The important thing that influences is the understanding of parents, support, and assistance.

Kay & Lauricella in Firman & Sari (2020:83) state that many students use laptops and smartphones in learning so as to allow students to take part in teaching and learning activities that are carried out in the form of video conferences or those carried out in online classes using available learning application services by online.

It is different from the application of online learning at the university level, because when viewed from the age level, you can think abstractly and systematically, the use of various applications in online learning can be done effectively and efficiently. In research Maulana (2021) states thatstudents in online learning carried out using Zoom Meeting and Google Classroom are in the good category. In this case, according to the level of student development and adaptive, responsive and creative attitudes, students do not experience difficult things in the process of implementing online learning with any application. Supported by research by Monica and Fitriawati (2020) stated that online learning using the Zoom application is in the effective category. Online learning received a very good response from students because learning is more flexible when using it. With online learning, students are more independent and encourage students to be more active in their studies. The many features in Zoom make learning more interesting.

The analysis of differences in platform usage at the primary, secondary and higher education levels above is a form of evidence that there are various reasons, as well as different problems from each condition experienced by the

elementary, secondary, and higher education unit levels, causing the impact of using online learning media platforms. different. This actually becomes a challenge how to get results in the form of maximum output from the various types of platforms used. Of course, the learning media platform is only a tool, so good communication is needed between educators and students so that they coordinate with each other in the learning process to produce the maximum level of achievement as expected.

D. Advantages and Disadvantages of LMS (Google Classroom, Edmodo, and Moodle)

Basically every learning management system (LMS) has advantages and disadvantages. However, the main focus is how an institution can use the LMS well and can help the learning process and not burden students. The main role of the LMS is only as a tool/technology that bridges and helps the learning process, while the main essence of the learning process is the competence of an educator and the ability to motivate students to learn well.

There are three types of LMS which are mostly used in elementary to tertiary level learning, including Google Classroom, Edmodo, and Moodle. Wicaksana et al. (2020), Usman et al. (2016) explain that the three types of LMS have advantages and disadvantages as shown in table 5.

Table 5. Advantages and disadvantages of LMS
(Google Classroom, Moodle, and Edmodo)

|	Advantages	Deficiency
Google Classroom	1. Very mobile friendly for beginners 2. Easily manage assigned tasks tugas 3. All files integrated into our Google Drive 4. Easily review assignments before sending 5. It's easy to see announcements from teachers 6. Free of ads and safe 7. Free	1. Display that is less attractive to students 2. When Google Drive is full the file can't be sent 3. Delivery time can still be arranged
Moodle	1. Easy to use 2. Easy installation process 3. Availability of quiz facilities, assignments, and scoring that can be arranged as needed 4. Has a large capacity for students 5. Supports several file types that can be used for the learning process 6. Contains a neat structure of teaching materials and can be made into several categories 7. Availability of language packs that can be selected according to needs. 8. Can change the appearance of the site because it is equipped with a menu to change themes.	1. Slow access time due to low bandwidth and poor design of materials with large file sizes 2. Less able to meet user needs caused by poor web learning application design so that it does not match user needs. 3. Users do not know and know well the system which from his own point of view, orientation according to how he sees things.

	9. free	
Edmodo	1. Easy to send files, pictures, videos and links.	1. Interference with internet connection can affect website running slower.
	2. Send individual messages to teachers.	2. Students are limited in access to exit, because they are only limited in that class
	3. Create groups for individual discussions by class or specific topic.	3. It's still in development and not completely perfect.
	4. Safe environment for new students.	
	5. Messages are designed to be easier to understand and not limited by the number of characters.	

E. Online Learning Management Using Education Smart Courses

In 2017 Indonesia had 4504 Universities have the most apprenticeship programs, i.e. educational apprenticeship programs. In short, the number of teaching and learning programs must be balanced with blockchain technology for it to function as it should. However, the increase in the number of study programs has not been matched by an even distribution of the digitization system*smart-courses* which uses blockchain at several universities in Indonesia and the world which results in a gap between traditional education & on-demand job market skills in the process of creating*soft skills*and *hard skills*thus providing a productive personality change and increasing morale.

Of course, the smart course support shown in Figure 2 below comes with a variety of devices that can be viewed by anyone at any time. Open to the public regardless of race, religion or gender. You can see it as an attempt to transform

the education and learning process in schools and universities into a digital format enabled by blockchain-based internet technology (Agustin et al., 2021).
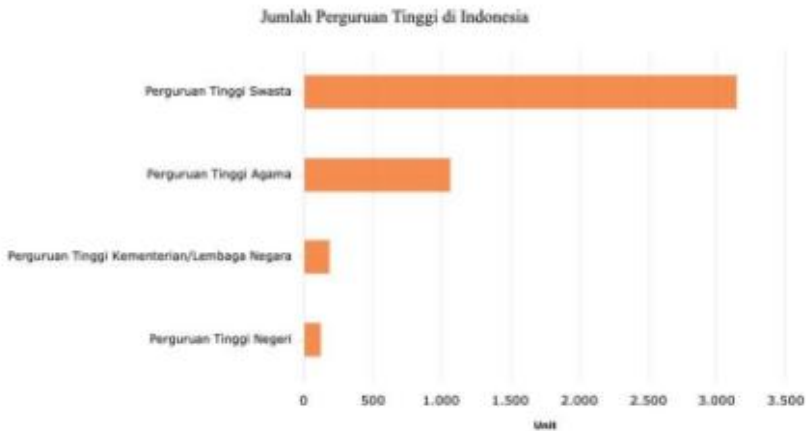
**Figure 1.** Number of Universities in Indonesia
Source: Ministry of Research Technology and Higher Education

On the other hand, some universities do not have specialists in a particular field of science, so it is not possible to acquire skills, but it is necessary for the development of intellectual courses for scholars at each university. 12/2012 concerning Higher Education Article 31 Paragraph 1 which states that distance education is a teaching and learning process carried out remotely through the use of various communication media. This means that the existence of distance education regulations can encourage Education Smart Courses (E-Scores) to be able to become a platform in the world of education in the form of gamification so that it creates a sense of enthusiasm and productivity (Arofah, E. F, 2018).
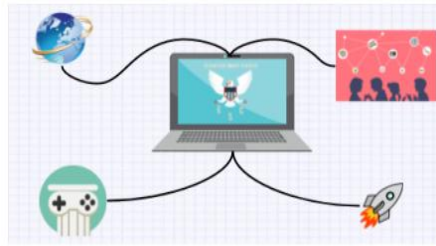
Figure 2. Smart-courses method technology

Users can improve their soft skills and hard skills with the gamification method. This needs to be realized so that not only 20 universities can realize online learning from a total of 4504 universities, which means that 0.4% has been realized, which is far from 100%. This condition allows educational intelligence courses (EScores) to play the role of sharing skills and research results through training with courses and incentives.
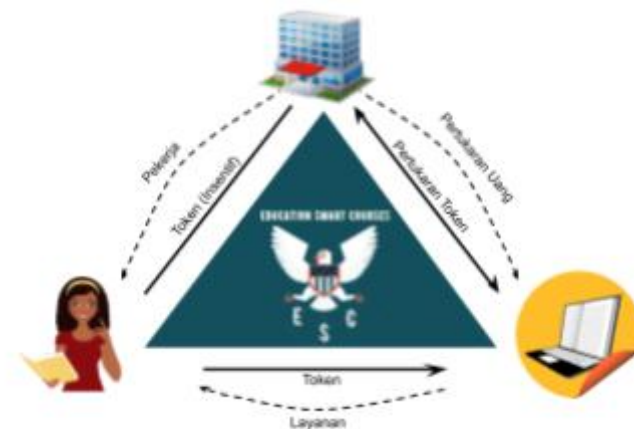
Figure 3. The smart-courses platform paradigm

It can be seen that with blockchain technology, online smart-courses can be realized so that universities apply this (Mayer, 2017). By using teaching materials in the form of e-

learning and its combination with other teaching materials in various forms, formats, media and from various sources combined with forms of gamification (Simanihuruk et al., 2019). This can be developed and packaged in various ICT-based forms in the training process. Utilizing a decentralized interactive course platform based on interactions between instructors and users using cryptocurrencies which can then be exchanged for digital goods and services. Based on studies that have been carried out by the JRC and the EU, it is proven that blockchain is very possible to be implemented in the field of education (Grech& Camilleri, 2017).
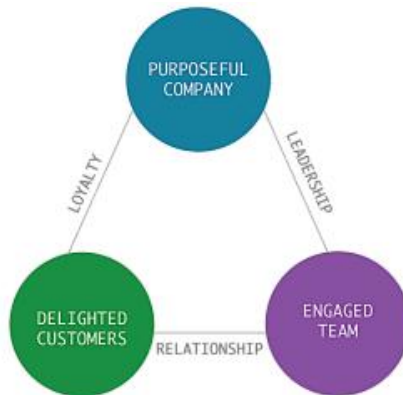
Figure 4. Education smart courses (E-Scores) support

Education Smart Courses (E-Scores) is an educational system innovation, especially in the field of courses that use application-based learning, enabling students to 'you understand, you profit' and receive cryptocurrency-based scholarships which can then be exchanged for digital goods and services using a decentralized platform that eliminates intermediary (Hileman& Rauchs, 2017).

Conclusion

The results of the critical review stated that the online learning media platforms used in Indonesia vary for three reasons, namely adjusting to the type of activity they do, such as conducting live in the form of synchronous, as well as non-live activities in the form of chatting with the excuse of minimizing quotas and networks in each Indonesian territory. then the use of asynchronous activities which in this case the platform used also adjusts because it is equipped with a learning management system. Other findings also show that MOOC-based activities are a form of distance learning method on a large scale, free and accessible to anyone and anywhere in the world.

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Online Teaching and Learning
in Science Education

The purpose of writing this book is to facilitate students in publishing review articles or research articles on technology and online learning pedagogy.

This book will discuss the following important topics: online learning technology research trends in science education from 2015 to 2020 in Indonesia, Project Based Learning (PjBL) to Project Based Online Learning (PjBOL), pedagogy in online learning, planning of online learning in science education, online pedagogical assessment, and selection of online learning media platform in Indonesia.